Value Engineering Study/ Planning Charette Report

Sutter Basin Pilot Study

January 2012

Prepared by

Value Management Strategies, Inc.

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Date: January 25, 2012

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Subject: Value Engineering Study/Planning Charette Report
Sutter Basin Pilot Study

Dear Mary:

Value Management Strategies, Inc. is pleased to transmit an electronic copy of the Final Value Engineering Study / Planning Charette Report.

This report summarizes the results and events of the workshop conducted October 31 – November 4, 2011 at the U.S. Army Corps of Engineers, Sacramento District offices.

We enjoyed working with you and are looking forward to continuing efforts to assist you and the Sacramento District in its value engineering efforts.

Sincerely,

VALUE MANAGEMENT STRATEGIES, INC.
Mark Watson, PE, CVS, PMP
VE Study Team Leader

VALUE MANAGEMENT STRATEGIES, INC.
Ronald J. Tanenbaum, PhD, PE, CVS
VE Study Team Leader

CC: Laura Whitney, Project Manager, USACE – Sacramento District

TABLE OF CONTENTS

FINAL

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

FINAL

A combined Value Engineering (VE) study and Planning Charette, sponsored by the US Army Corps of Engineers (USACE), Sacramento District and facilitated by Value Management Strategies, Inc., was conducted on the Sutter Basin Pilot Study. The study was conducted in Sacramento, California October 31 – November 4, 2011. The VE study involved the USACE Sacramento District Project Development Team (PDT) working with designated representatives from USACE South Pacific Division, the California Department of Water Resources (DWR), and Sutter Butte Flood Control Agency (SBFCA).

PROJECT SUMMARY

USACE and SBFCA, in coordination with DWR and the California Central Valley Flood Protection Board are undertaking efforts to study flood risk management measures in Sutter and Butte Counties. The Sutter Basin, California Feasibility Study will investigate flood damage reduction, ecosystem restoration and recreation within the project's study area.

The Sutter Basin Feasibility Study was selected for inclusion in the National Pilot Program in February 2011. The pilot initiative provides an opportunity to test principles that have been outlined in the U.S. Army Corps of Engineers (USACE) Recommendations for Transforming the Current Pre-Authorization Study Process (January 2011), which was drafted by a workgroup of planning and policy experts from USACE and the Office of the Assistant Secretary of the Army for Civil Works referred to as the 17+1 Team. Based on these principles, the Sutter Pilot Study plan formulation strategy focuses on a qualitative analysis that will be increasingly detailed at each Decision Point or In-Progress Review, and early elimination of plans with little probability of implementation.

WORKSHOP TIMING

The VE study/Planning Charette was conducted early in Project Development prior to the Feasibility Report being prepared by USACE Sacramento District.

VE STUDY/PLANNING CHARETTE OBJECTIVES

The objectives of the VE study as identified in the scope of work were to:

- **Validate, Refine, and Optimize Alternatives** – Integrate VE principles, tools and techniques into the project's early decision making processes to validate, refine, and optimize preliminary alternatives and ensure a robust final array of alternatives.
- **Facilitate Communication** – Utilize the VE process to facilitate and encourage the understanding, consideration, and integration of the needs of the PDT members, project sponsors, partners, and other stakeholders.
- **Improve Value** – Identify VE Concepts that improve the project's ability to meet its objectives through increased performance and/or reduced cost.

- **Improve Planning Process** – Combine the VE methodology (5-step job plan) with USACE's 6-step planning process in order to meet both the project and pilot study objectives.

BASELINE CONCEPTUAL ALTERNATIVES AND MEASURES

Prior to the workshop, the PDT in conjunction with the local sponsors, identified a wide array of potential Flood Risk Management (FRM) structural and nonstructural measures, Ecosystem Restoration (ER) measures (in conjunction with FRM), and recreation measures.

The measures were then grouped into one or more conceptual alternatives. Measures listed under each conceptual alternative were designated as either required measures or optional measures that could be incrementally added to the alternative. The measures were formed into nine preliminary alternatives which are summarized in the Project Information section of this report. Since the measures to be included in the nonstructural alternative have not yet been well defined, this alternative was not rated during the VE Study. By policy, a primarily nonstructural alternative will be included in the final array.

WORKSHOP RESULTS

The VE team undertook the task assignment using the VE work plan and methodology. Given that this study was conducted at an early stage of design development, the VE team considered a "top down" approach where the team identified and discussed the general objectives of the project as they relate to the project's purpose and need.

The most notable result of this workshop was the use of the VE methodology at an early stage of design. Traditionally, VE studies are performed later in the design process with the intent to identify cost savings and value improvement suggestions on an existing design. For this study, the VE team used the tools and techniques of the VE methodology to accomplish the stated objectives. The VE study completed the following activities:

- Discuss and concur on the project's mission (purpose and need)
- Identify and prioritize the performance criteria for the project
- Evaluate the Baseline Conceptual Alternatives per the performance criteria and relative costs
- Revise Conceptual Alternatives and identify Final Alternative Array
- Evaluate Final Alternative Array per the performance criteria and relative costs

EVALUATION OF BASELINE CONCEPTUAL ALTERNATIVES

During the course of the workshop, a number of analytical tools and techniques were applied to develop a better understanding of the Baseline Alternative Concepts and begin the process of identifying a final array of alternatives. A major component of this analysis was Value Metrics which seeks to assess cost and performance as they relate to project value. These elements required a deeper level of analysis, the results of which are detailed in this report. Key performance attributes identified for the project are listed in the table, "Performance Attributes."

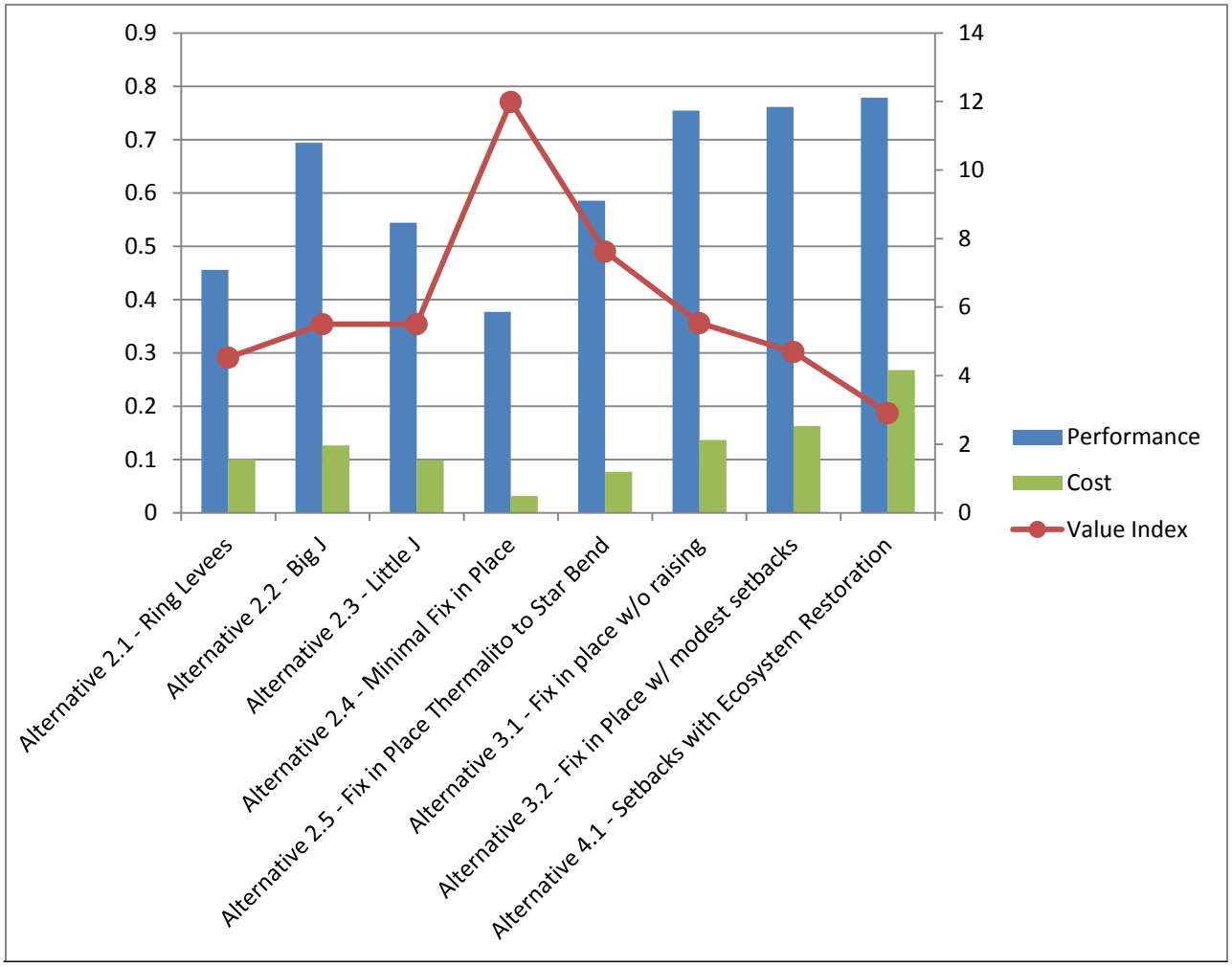
Performance Attributes
Flood Risk Management
Residual Risks
Sustainability
Ecosystem Functionality
Minimize Environmental Impacts

The *Comparison of Value* chart presented below was prepared to summarize the comparison of the Baseline Conceptual Alternatives. The performance scores calculated from the summation of the weighted priority of a performance attribute times an alternative's rating score for the attribute were divided by the total cost scores for each alternative to derive a value index.

The basic equation for value is:

$$Value = \frac{Performance}{Cost + Time}$$

Comparison of Value – Baseline Concepts



Below is a summary of the major observations and conclusions identified during the value analysis of the Baseline Conceptual Alternatives:

- USACE policy requires a predominantly non-structural alternative, however, a stand-alone non-structural alternative (*Alternative 1.1 – Non-Structural Measures*) does not significantly address project objectives due to residual risk. Non-structural measures would enhance all project alternatives in achieving objectives and should be considered in combination with other alternatives.

- *Alternative 4.1 – Setbacks with Ecosystem Restoration* has significantly higher costs than the other alternatives with only slightly added performance. This alternative was eliminated from further consideration because the additional cost of this alternative compared to combined alternatives 3.1 and 3.2 exceeds the additional restoration benefits. The ecosystem benefits from setbacks can be evaluated as standalone additions to other alternatives.

- The performance and costs of *Alternative 3.1 – Fix in Place without Raising* and *Alternative 3.2 – Primarily Fix in Place, Including Modest Setbacks* are relatively the same. The alternatives differ primarily in the optional setbacks they include. The setbacks can be evaluated as standalone additions to the combined alternative.
- Early economic benefit analysis leads to preliminary conclusion that smaller rings around the communities of Biggs, Gridley and Live Oak would not be economically justified, however, the Yuba City ring levee may be justified.
- *Alternative 2.4 – Minimal Fix in Place* provides flood risk reduction to a significant portion of the economic development of the study area for a relatively low construction cost.

VE CONCEPTS SUMMARY

The VE portion of the workshop identified 18 concepts, which are intended to assist the project development team in refining plans to carry forward into the next phase of project development. The concepts could potentially add value to the project, either through enhancing project functionality and alignment with project objectives, performance improvements, risk reduction, or any combination thereof. The alternatives are organized by category based on the project issue or project aspect they address. A summary list and developed content of all of the VE Concepts is included in the *VE Concepts* section of this report.

FINAL ALTERNATIVE ARRAY

Using the results of the previous exercises, the VE team developed a suggested Final Alternative Array. The alternatives are summarized below. Additional information, assumptions, and the performance assessment for each alternative are included in the *Value Analysis of Final Alternatives Array* section of this report.

- **Primarily Nonstructural with Minimal Levee Improvement Reaches**
  This alternative is a combination of minimal levee improvements to Feather River Levees with the implementation of non-structural measures focused on reducing risk to loss of life.

- **Yuba City Ring Levee**
  This alternative consists of constructing a ring levee around Yuba City only with the implementation of non-structural measures focused on reducing risk to loss of life in areas not provided with new or improved levees.

- **Little "J" Levee**
  This alternative consists of improving the Feather River levees from Thermalito to Shanghai Bend and constructing a new levee to the south and west of Yuba City.

- **Fix in Place Feather River Thermalito to Star Bend**
  This alternative consists of improving the Feather River levees from Thermalito to Star Bend. The alternative also includes the Star Bend setback levee.

- **Fix in Place Feather River, Sutter Bypass, and Wadsworth Canal with select setbacks for ecosystem restoration**
  This alternative is a combination of Alternatives 3.1 and 3.2 as originally identified with the Star Bend setback levee and the Northern Feather River setback levees included. The alternative will consider economic and flood risk reduction justification for other setback levee alignments and isolated weak spots as supplemental options where feasible.

CONCLUSION

This study accomplished each of its objectives as summarized below.

Validate, Refine, and Optimize Alternatives – The VE Study/Planning Charette resulted in narrowing the alternative array to a select number of alternatives. The study further provides information on the performance of each alternative as it relates to the purpose and need of the project. Given that this project is at an early stage in project development, no specific alternative or concepts were selected by the VE team as a "most preferred" solution. However, as the feasibility study process continues, it is recommended that the results documented in this report be utilized to aid in the decision-making process.

Facilitate Communication – The VE team incorporated the project objectives and discussions on the project's purpose and need into a mission statement that succinctly summarizes the project's scope. The VE team then utilized function analysis techniques to translate the project's purpose and need into functions in order to further understand how the project is accomplishing its objectives.

Improve Value – The VE team identified 15 VE Concepts that focus primarily on optimization of the Baseline Conceptual Alternatives array through either incorporating additional flood risk reduction measures and/or modifying the Conceptual Alternatives per lessons learned during the previous workshop exercises (Function Analysis and Value Metrics). The VE team also identified suggested revisions to the Baseline Conceptual Alternative array through the combination of certain alternatives or the elimination of alternatives from further consideration.

Integration with Planning Process – The following comments and lessons learned were generated by the participants at the conclusion of the workshop:

- The VE study allowed decisions to be made based on logical, repeatable, and defendable means without the need for significant data generation. The Value Metrics process utilized multi-criteria decision making without the need for full development of all the alternatives in order to reach preliminary screening decisions. This will result in time and effort savings as the planning process continues.
- The Performance Attributes as identified, defined, and prioritized by the Value Metrics process need to be reviewed to ensure that they reflect current USACE policies. Challenge ahead is to get more quantification of the information for rating the alternatives per the attributes identified.

- The VE Process as it has been adapted for this workshop is a complimentary method to USACE's traditional planning process and allowed issues to be brought up and discussed in an open forum and then resolved through creative and consensus-building activities. This collaborative approach allows more to happen in a reduced timeframe than the traditional report/comment/revision methods.
- This was the right time to incorporate VE into the project development process. Validated the effort to this point is in the right direction without requiring significant re-work. Using internal team at this point in the process is essential for good evaluation of the project and taking advantage of the institutional knowledge of the project and alternatives.

PROJECT INFORMATION

PROJECT INFORMATION

BACKGROUND

The U.S. Army Corps of Engineers and the Sutter Butte Flood Control Agency, in coordination with the California Department of Water Resources and the California Central Valley Flood Protection Board are investigating flood risk management in Sutter and Butte Counties. The purpose of the investigation is to address deficiencies in the existing levee system along the Feather River and Sutter Bypass that may lead to flood damage.

This project was one of two projects selected for a new pilot program to shorten the Corps' current study process target of three years. The pilot program is intended to test and confirm ideas for shortening the Corps' planning study process to as few as 18 months, as part of a broader Corps effort to respond to the nation's needs by moving more quickly from studying a problem to fixing it. One method for fast-tracking the Corps' planning process is to screen potential alternatives using logical, transparent, and policy-compliant methods based more on expert judgment rather than detailed quantitative analysis.

PROJECT DESCRIPTION

The Sutter Basin, California Feasibility Study is investigating flood risk management, ecosystem restoration and recreation within the study area. The study is considering improvement of the existing levees, as well as construction of new levees and other structural and non-structural measures for flood damage reduction. The ecosystem restoration and recreation objectives would be secondary to the flood damage reduction objective.

There exists a high risk of flooding from levee failure which threatens the public safety of approximately 80,000 people, as well as property and critical infrastructure throughout the study area. In addition, existing levees have isolated the floodplains from waterways, which eliminated significant floodplain habitats for native species, including federally listed species and other special status species.

Project Objectives

Based upon the information and discussions generated prior to the workshop, the following are the project objectives:

- Reduce the risk to life, health, and public safety due to flooding
- Reduce the risk of property damage due to flooding
- Reduce the risk of damage to critical infrastructure due to flooding
- Encourage wise use of the floodplain
- In conjunction with FRM, restore floodplain connectivity and associated dynamic riverine processes

- In conjunction with FRM, restore aquatic, wetland, riparian, and terrestrial habitats for special status and other native species
- In conjunction with FRM and ER, improve the public's access to and use of outdoor recreational opportunities in the study area

Project Mission Statement

The VE team incorporated the project objectives and discussions on the project's purpose and need into the following mission statement:

> *The Sutter Basin Flood Risk Management project is a multi-purpose approach to fix an unacceptable risk (probability and consequences) to life safety, public safety, critical infrastructure and property from flooding in the project area through structural and non-structural measures, incorporating ecosystem restoration and recreation opportunities, where appropriate.*

BASELINE CONCEPTUAL ALTERNATIVES

Prior to the VE Study/Planning Charette, the project team evaluated potential flood risk reduction, ecosystem restoration and recreation measures with respect to the study objectives and constraints. The result of a Critical Thinking Charette was an array of 33 measures. These measures were formed into eight preliminary alternatives as follows:

- **Alternative 1.1 – Non-Structural Measures**
  Since the measures to be included in the nonstructural alternative have not yet been well defined, this alternative was not evaluated during the combined VE Study/Charette. By policy, a primarily nonstructural alternative will be included in the final array.

- **Alternative 2.1 – Ring Levees**
  This alternative consists of ring levees around the communities of Biggs, Gridley, Live Oak, and Yuba City. The heights of the Biggs, Gridley, and Live Oak ring levees were estimated based on the 1/500 AEP levee breach inundation depths and an assumed additional height to provide 90% reliability. The height of the Yuba City ring levee was estimated based on the 1/200 AEP levee breach floodplain and additional height to provide 90% reliability. The eastern flank of the Yuba City ring levee would utilize the existing Feather River levee. The existing levee would be strengthened in place to its existing authorized height with no raising and would meet current USACE design standards. The higher level of performance for the Biggs, Gridley, and Live Oak ring levees was utilized because the flood depths are relatively shallow and do not vary significantly between flood frequencies. Each ring levee was assumed to require a pump station to address interior drainage. The capacity of the pump station was based on the rational method.

- **Alternative 2.2 – Big J**
  This alternative includes strengthening the Feather River levees from Thermalito to Star Bend, constructing a new cross-levee from Star Bend to Gilsizer Slough, strengthening the Sutter Bypass levee from Gilsizer slough to Wadsworth canal, and strengthening the south levee of the Wadsworth canal. All fix in place levees would meet current USACE design standards and

would be strengthened to the existing authorized height with no raising. The new levee reach was assumed to be a straight line profile from the Feather River levee to the Sutter Bypass levee. The levee footprint follows the approximate drainage divide to the two existing DWR pumping plants. Therefore, additional pumping plants would not be required. This alternative also includes the Star Bend setback levee.

- **Alternative 2.3 – Little J**
  This alternative includes strengthening in place Feather River levees from Thermalito to Shanghai Bend and constructing a new levee to the south and west of Yuba City. All fix in place levees would meet current USACE design standards and would be strengthened to the existing authorized height with no raising. The "J" levee was assumed to require a pump station to address interior drainage. The capacity of the pump station was based on the rational method.

- **Alternative 2.4 – Minimal Fix in Place**
  This alternative consists of strengthening in place the Feather River levees from Sunset Weir to Star Bend. All fix in place levees would meet current USACE design standards and would be strengthened to the existing authorized height with no raising.

- **Alternative 2.5 – Fix in Place Thermalito to Star Bend**
  This alternative consists of fixing in place Feather River levees from Thermalito to Star Bend and corresponds to the Feather River West Levee Project. The alternative also includes the Star Bend setback levee. All fix in place levees would meet current USACE design standards and would be strengthened to the existing authorized height with no raising.

- **Alternative 3.1 – Fix in Place without Raising**
  This alternative consists of fixing in place the Feather River levees from Thermalito to the confluence with the Sutter Bypass and improving the east levees of the Sutter Bypass in the southern basin. Levees along the south side of Wadsworth Canal would also be improved. The alternative also includes the Star Bend setback levee. All fix in place levees would meet current USACE design standards and would be strengthened to the existing authorized height with no raising.

- **Alternative 3.2 – Primarily Fix in Place, Including Modest Setbacks with Ecosystem Restoration**
  This alternative is similar to Alternative 3.1. However, in lieu of fixing in place the existing levees, new setback levees would be constructed at Northern Feather River and at the Sutter Bypass and Feather River confluence. The alternative also includes the Star Bend setback levee.

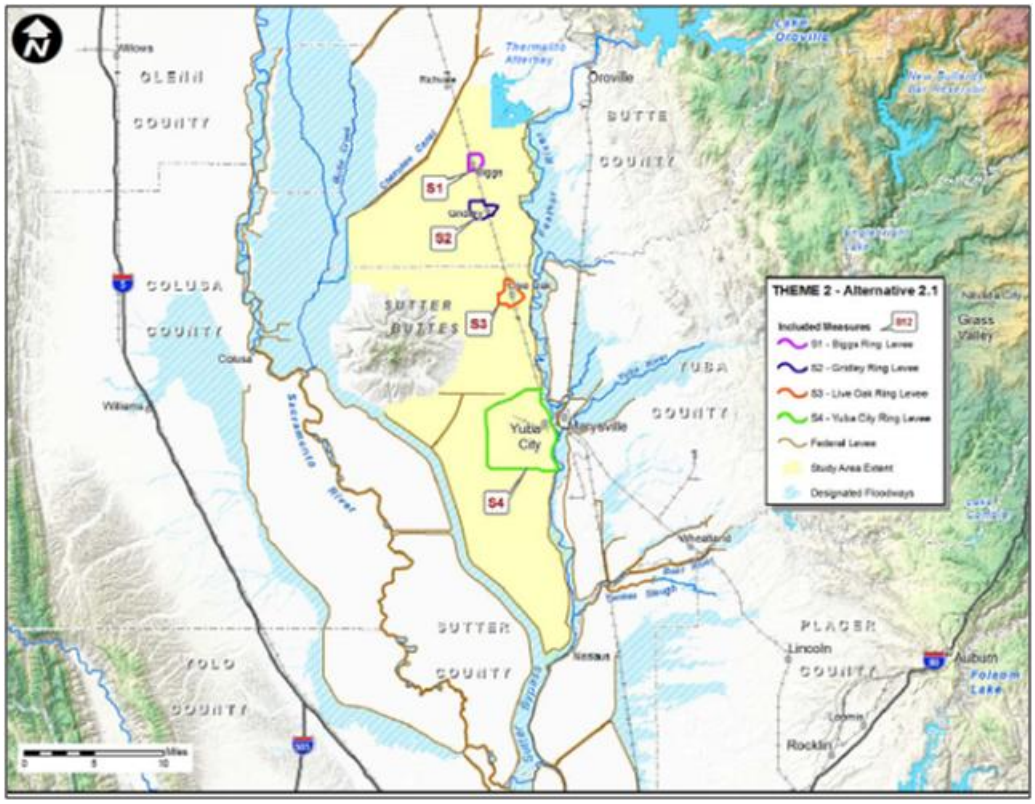
- **Alternative 4.1 – Setbacks with Ecosystem Restoration**
  This alternative is similar to Alternative 3.2. However, in lieu of improving the existing Sutter Bypass levee, a new setback levee would be constructed along the Sutter Bypass.

BASELINE CONCEPTUAL ALTERNATIVE SKETCHES

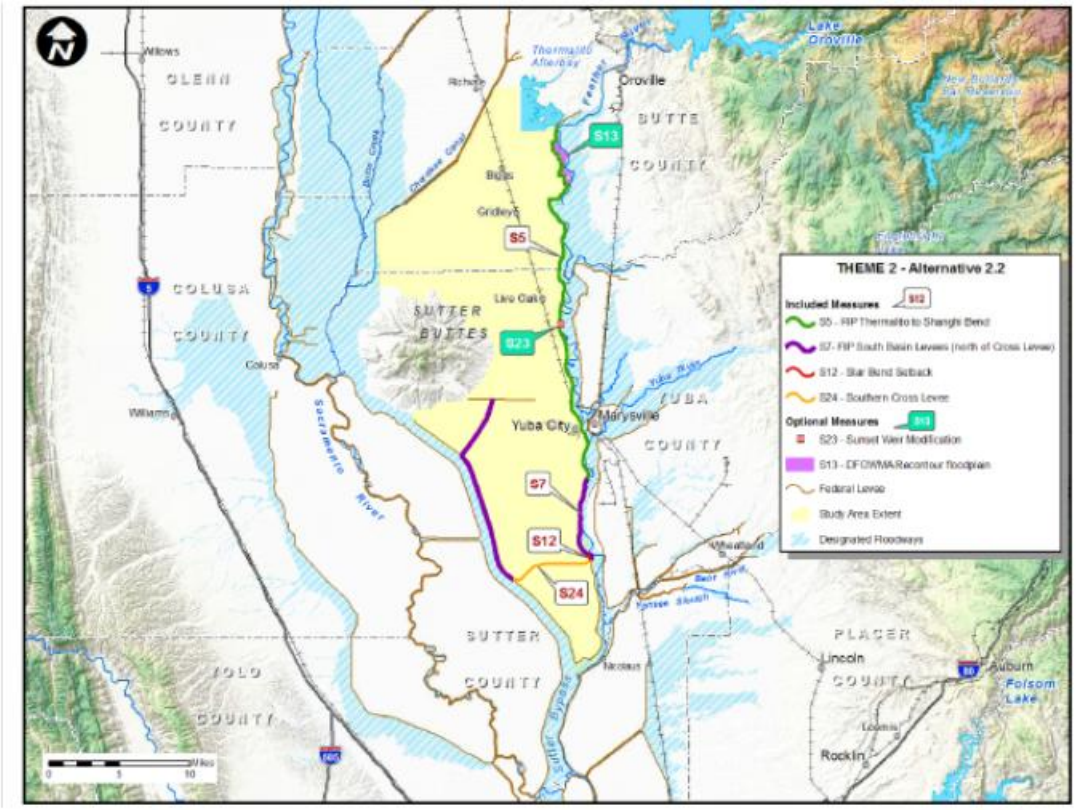
Conceptual illustrations of the Baseline Alternatives are included below and on the following pages.

BASELINE CONCEPTUAL ALTERNATIVES AND MEASURES

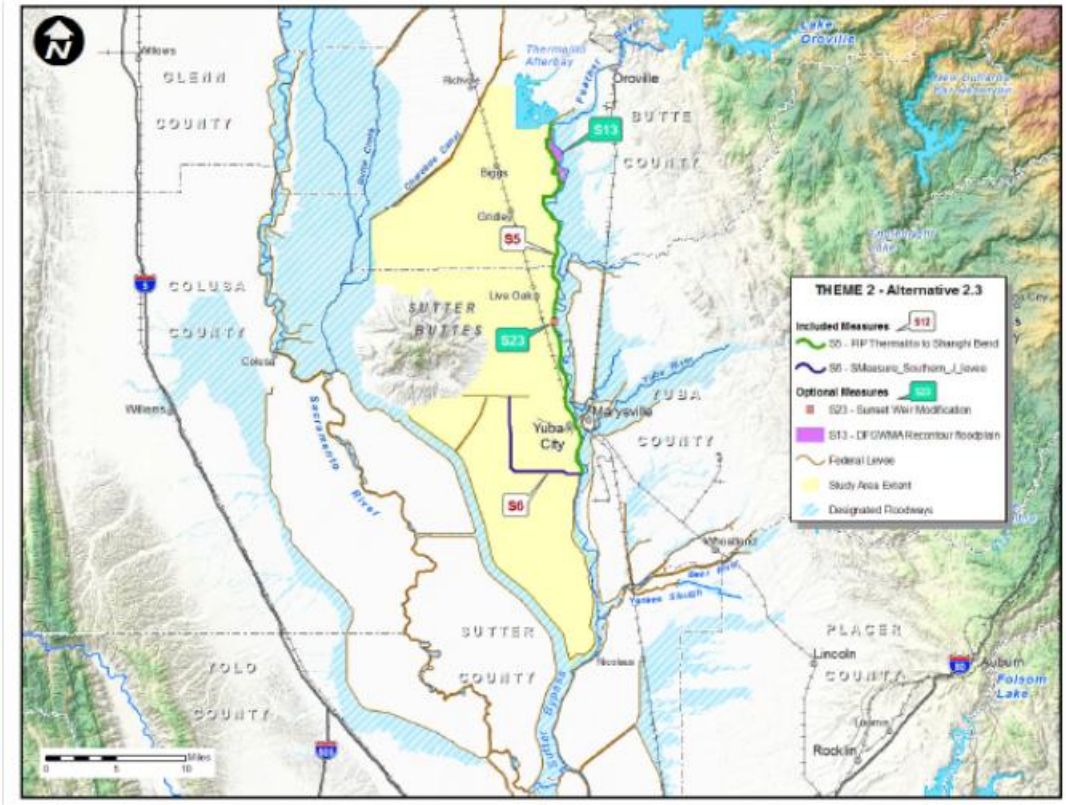
A table summarizing the potential flood risk reduction measures and the measures that comprise the Baseline Conceptual Alternatives is included at the end of this section.



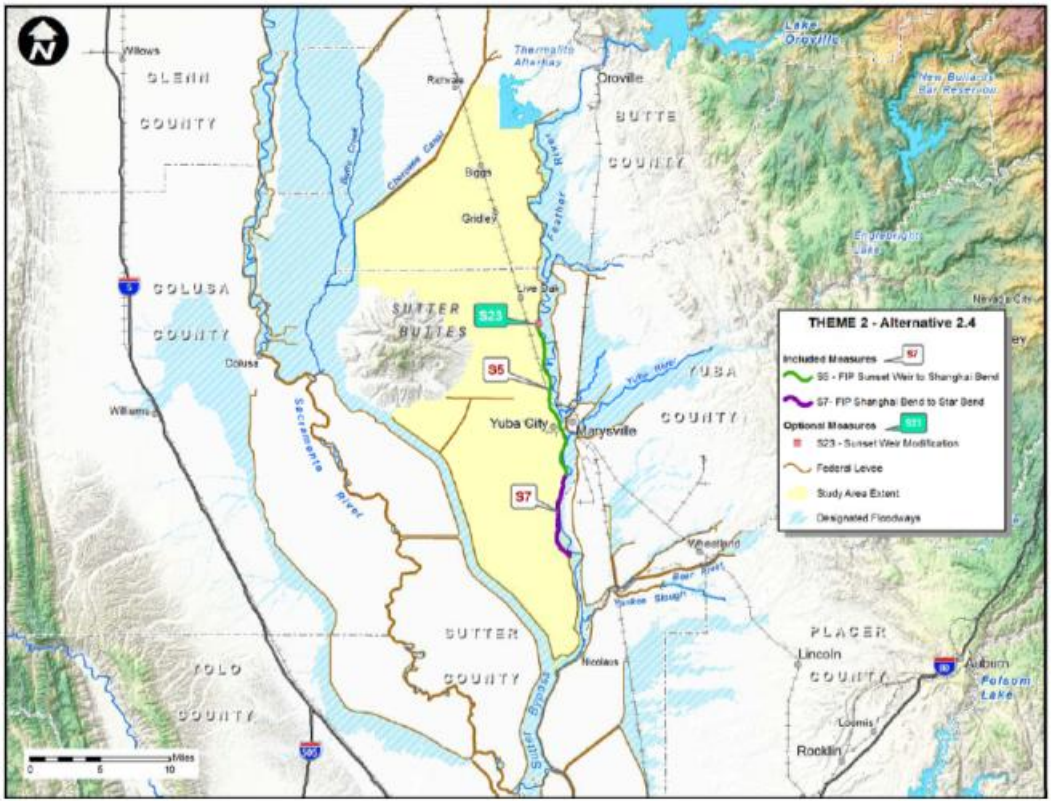
Alternative 2.1 – Ring Levees



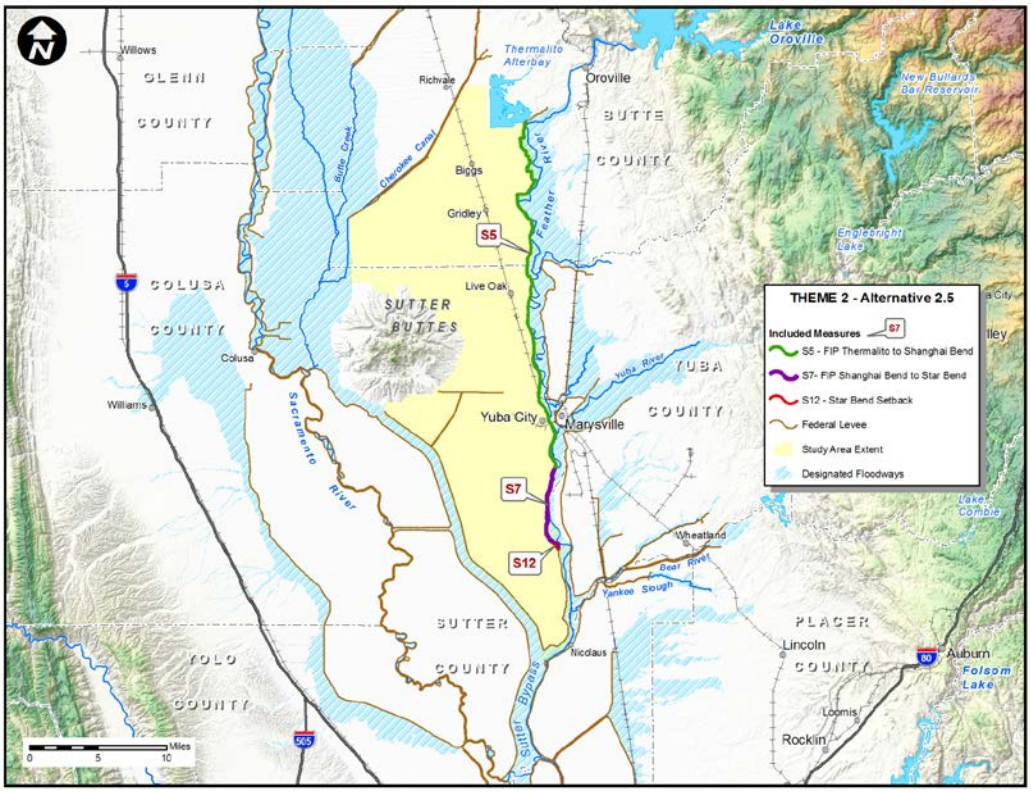
Alternative 2.2 – Big J



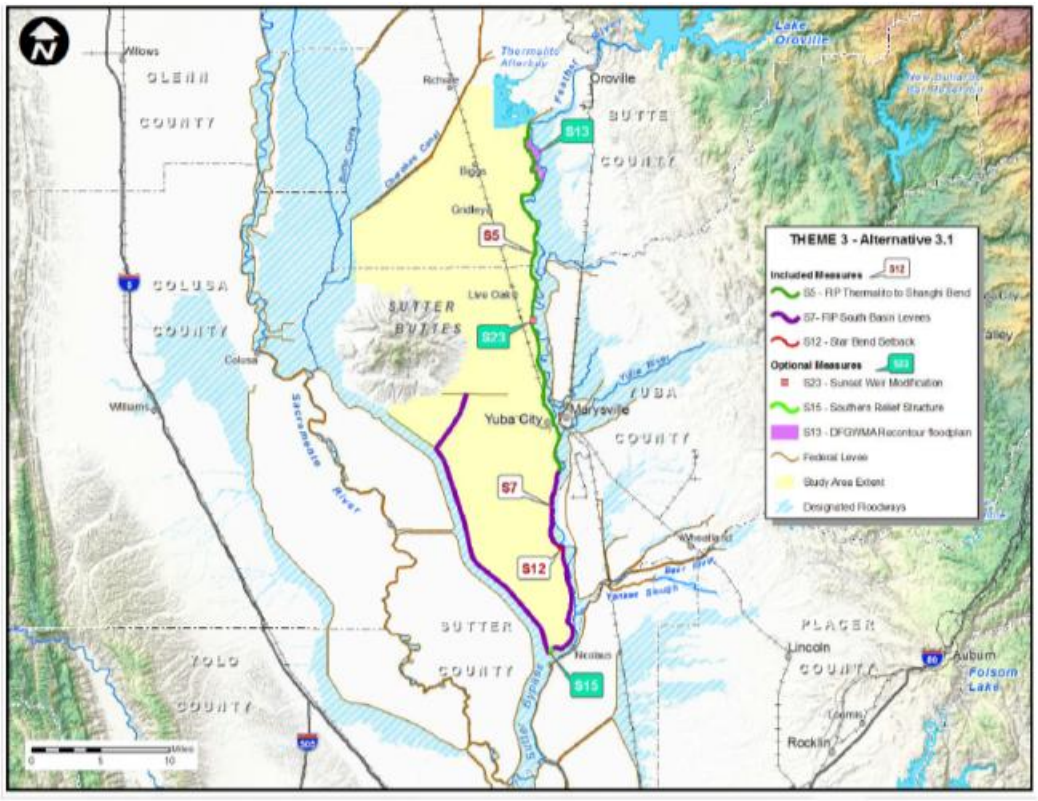
Alternative 2.3 – Little J



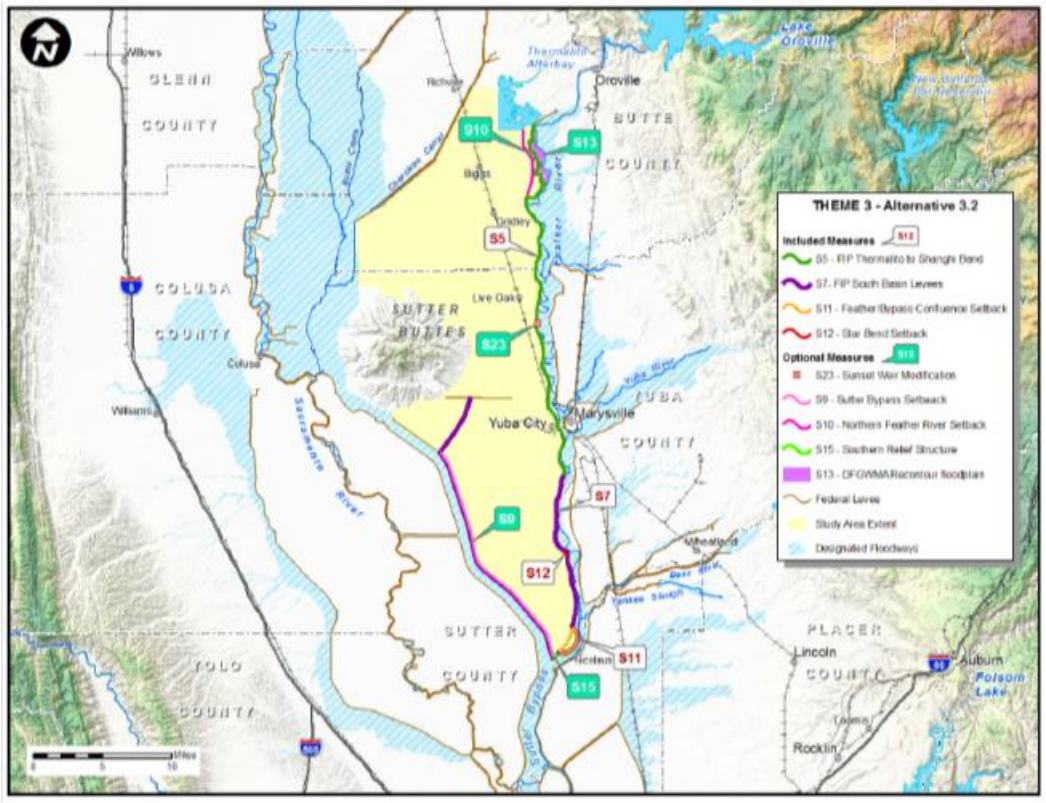
Alternative 2.4 – Minimal Fix in Place



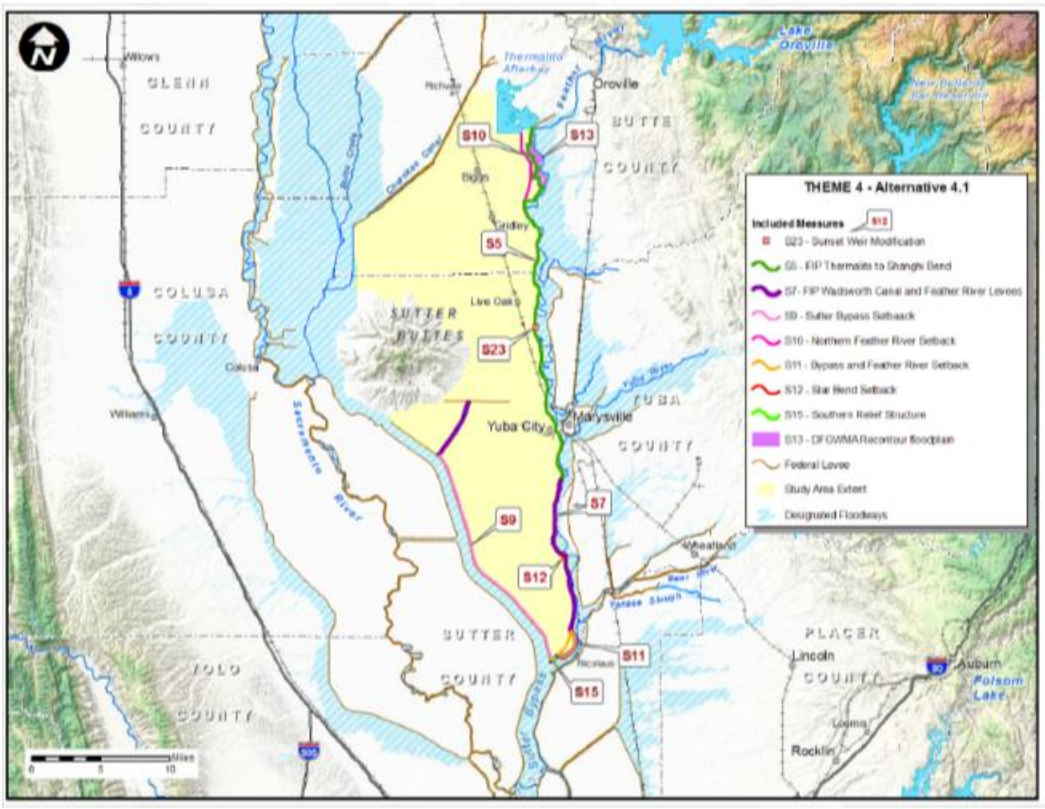
Alternative 2.5 – Fix in Place Thermalito to Star Bend



Alternative 3.1 –Fix in Place without raising



Alternative 3.2 – Primarily Fix in Place with modest setbacks



Alternative 4.1 – Setbacks with Ecosystem Restoration

Conceptual Alternatives and Measures

ID	Management Measures	**Theme 1 Consequence Management focused on Public Safety**	**Alternative 1.1:** Nonstructural	**Theme 2 Urban FRM Focus**	**Alternative 2.1:** Ring Levees	**Alternative 2.2:** Big J	**Alternative 2.3:** Little J	**Alternative 2.4:** Minimal Fix in Place	**Alternative 2.5:** Fix in Place Thermalito to Star Bend	**Theme 3 Maximize Existing System with FRM Emphasis**	**Alternative 3.1:** Fix in place w/o raising	**Alternative 3.2:** Primarily Fix in Place including modest setbacks	**Theme 4 Ecosystem Emphasis**	**Alternative 4.1:** Setbacks with Ecosystem Restoration
S1	Biggs Ring Levee			*	X									
S2	Gridley Ring Levee			*	X									
S3	Live Oak Ring Levee			*	X									
S4	Yuba City Ring Levee			*	X									
S5	Fix-In-Place Feather River West Levee from Thermalito to Shanghai Bend			*		X	X	X-SBFCA segment 4 and 5 only (Sunset Weir to Shanghai Bend)	X	*	X-may include sub reaches	X	*	X
S6	Southern Portion of J-Levee			*			X							
S7	Fix-In-Place Feather River West Levee from Shanghai Bend to Sutter Bypass; plus Wadsworth Canal East Levee; plus Sutter Bypass East Levee			***- south to star bend only**		X-Feather River North of Star bend and SB north of Gilsizer slough		X- Shanghai Bend to Star Bend	X- Shanghai Bend to Star Bend	*	X- may include sub reaches	X	***-w/o Sutter bypass fix in place**	X-w/o Sutter bypass fix in place
S9	Sutter Bypass Setback Levee									*		O	*	X
S10	Northern Feather River Setback Levee			*						*		O	*	X
S11	Sutter Bypass and Feather River Confluence Setback Levee									*		X	*	X
S12	Star Bend Setback Levee			*		X			X	*	X	X	*	X
S13	Oroville DFG Wildlife Management Area – Degrade Land Surface and Restore Wetlands					O	O				O	O	*	X
S15	Southern Relief Feature	*	O	*						*	O	O	*	X
S23	Sunset Weir Modification			*		O	O	O		*	O	O	*	X
S24	Gilsizer Cross Levee with flap gates	*		*		X								
S25	Wadsworth Canal Tributary Drainage			*		O	O			*	O	O		

ID	Management Measures	**Theme 1 Consequence Management focused on Public Safety**	**Conceptual Alternative 1.1:** Nonstructural	**Theme 2 Urban FRM Focus**	**Conceptual Alternative 2.1:** Ring Levees	**Conceptual Alternative 2.2:** Big J	**Conceptual Alternative 2.3:** Little J	**Conceptual Alternative 2.4:** Minimal Fix in Place	**Conceptual Alternative 2.5:** Local Early Implementation Plan Project #1	**Theme 3 Maximize Existing System with FRM Emphasis**	**Conceptual Alternative 3.1:** Fix in place w/o raising	**Conceptual Alternative 3.2:** Primarily Fix in Place including modest setbacks	**Theme 4 Ecosystem Emphasis**	**Conceptual Alternative 4.1:** Setbacks with Ecosystem Restoration
S26	Managed overtopping (levee superiority) on Feather River and Sutter Bypass. (e.g. selective levee raising)			*		O	O	O		*	O	O		
S27	Improve upstream fish passage in Sutter Bypass. (Remove fish passage barriers). Dependent on S9												*	X
NS1	Strategic relocation of structures and critical infrastructure in floodplain	*	O	*	O	O	O	O	O		O	O	*	O
NS2	Floodproof at isolated locations	*	O	*	O	O	O	O	O	*	O	O	*	O
NS3	Elevate structures and transportation infrastructure	*	O	*	O	O	O	O	O	*	O	O	*	O
NS4	Establish flood-resistant housing	*	O	*	O	O	O	O	O		O	O	*	O
NS5	Secure large floatable objects	*	O	*	O	O	O	O	O	*	O	O	*	O
NS6	Flood-warning system	*	X	*	X	X	X	X	X	*	X	X	*	X
NS7	Evacuation plan	*	X	*	X	X	X	X	X	*	X	X	*	X
NS8	Construct ring levees at isolated locations.	*	O	*	O	O	O	O	O		O	O	*	O
R1	Multi-Use Trails	*	O	*	O	O	O	O	O	*	O	O	*	O
R2	Bicycle Trails	*	O	*	O	O	O	O	O	*	O	O	*	O
R3	Equestrian Trails	*	O	*	O	O	O	O	O	*	O	O	*	O
R4	Day Use Area	*	O	*	O	O	O	O	O	*	O	O	*	O
R5	River Access	*	O	*	O	O	O	O	O	*	O	O	*	O
R6	Scenic Overlook	*	O	*	O	O	O	O	O	*	O	O	*	O
R7	Recreational parkway	*	O	*	O	O	O	O	O	*	O	O	*	O

* Included in theme
X Included in alternative
O Optional to alternative

FUNCTION ANALYSIS

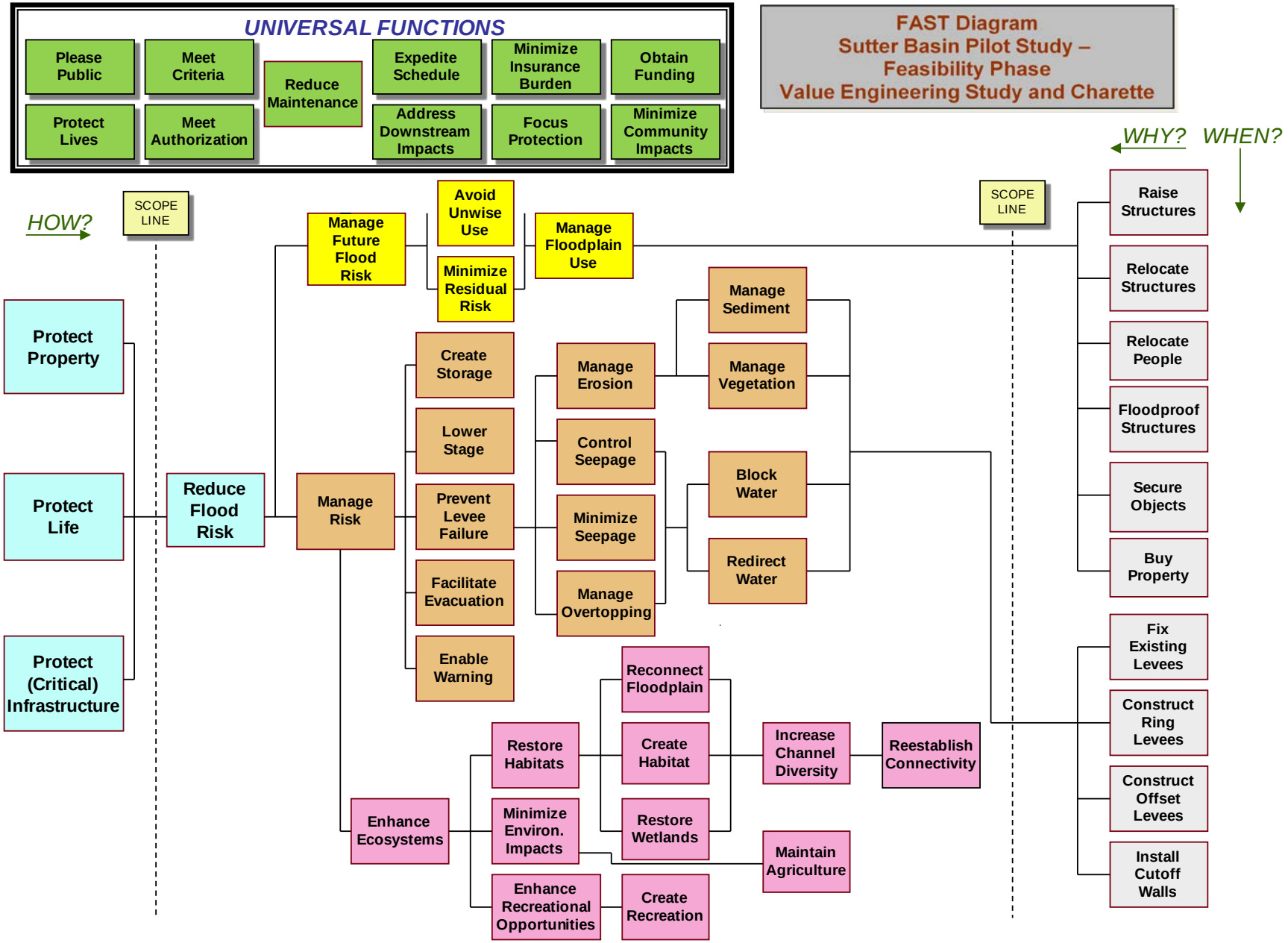
Function analysis was performed and a Function Analysis System Technique (FAST) Diagram was produced, which revealed the key functional relationships for the project. This analysis provided a greater understanding of the total project and how the project's performance, cost, time, and risk characteristics are related to the various functions identified.

The FAST diagram arranges the functions in logical order so that when read from left to right, the functions answer the question, "How?" If the diagram is read from right to left, the functions answer the question, "Why?" Functions connected with a vertical line are those that happen at the same time as, or are caused by, the function at the top of the column (a "When?" relationship).

Random Function Determination

Function	Function
Protect Life	Reconnect Floodplain
Reduce Flood Risk	Create Habitat
Protect Property	Restore Wetlands
Protect Infrastructure	Lower Stage
Enhance Ecosystems	Manage Floodplain Use
Restore Habitats	Create Recreation
Enhance Recreational Opportunities	Reestablish Connectivity
Fix Existing Levees	Maintain Agriculture
Construct Offset Levees	Meet Criteria
Minimize Environmental Impacts	Avoid Unwise Use
Relocate People	Manage Future Flood Risk
Raise Structures	Manage Vegetation
Relocate Structures	Protect Critical Infrastructure
Floodproof Structures	Create Storage
Control Seepage	Obtain Funding
Minimize Seepage	Minimize Community Impacts
Secure Objects	Increase Channel Diversity
Improve Access	Minimize Residual Risk
Facilitate Evacuation	Reduce Maintenance
Manage Overtopping	Address Downstream Impacts
Provide Warning	Manage Sediment
Block Water	Manage Erosion
Construct Ring Levees	Expedite Schedule

FAST Diagram



VALUE ANALYSIS OF BASELINE CONCEPTS

VALUE ANALYSIS OF BASELINE CONCEPTS

SUMMARY OF ANALYSIS

Value Metrics was used as an analysis tool to evaluate the Baseline Alternative Concepts that were identified prior to the workshop.

VALUE METRICS

Value Methodology (VM) has traditionally been perceived as an effective means for reducing project costs. This paradigm only addresses one part of the value equation, oftentimes at the expense of the role that VM can play with regard to improving project performance. Project costs are fairly easy to quantify and compare; performance is not.

Project performance must be properly defined and agreed to by the stakeholders at the beginning of the VE study/Planning Charette. The performance requirements and attributes developed are then used throughout the study to identify, evaluate, and document alternatives. This process, Value Metrics, emphasizes the interrelationship between the elements of performance, cost, and time and can be quantified and compared in terms of how they contribute to overall value. The basic equation for value is:

$$Value = \frac{Performance}{Cost + Time}$$

Value Metrics provides a standardized means of identifying, defining, evaluating, and measuring performance. Once this has been achieved and costs for all VE alternatives have been developed, measuring value is very straightforward.

The following pages describe the steps in the Value Metrics process.

Define Performance Requirements

Performance requirements represent essential, non-discretionary aspects of project performance. Any concept that fails to meet the project's performance requirements, regardless of whether it was developed during the project's design process or during the course of the VE study, cannot be considered as a viable solution. Concepts that do not meet a performance requirement cannot be considered further unless such shortcomings are addressed through the VE study process in the form of VE alternatives. It should be noted that in some cases, a performance requirement may also represent the minimum acceptable level of a performance attribute. The following performance requirements were selected for this project.

Performance Requirement	Definition
Meet Applicable Environmental Regulatory Standards and Policies	Project must meet the environmental regulatory standards and policies applicable to the respective project development stage. Examples include the National Environmental Policy Act, Endangered Species Act, Fish and Wildlife Coordination Act, Clean Water Act, Clean Air Act, and the National Historic Preservation Act. Meet State of California policies and regulatory standards.
Maintain Existing Flood Protection	The level of protection provided by floodwalls and levees must not be reduced.
Distinctiveness	Alternative measures should be unique and identifiable to allow distinguishing amongst the final array of alternatives.
Complete and Independent Project	This requirement is a determination of whether or not the plan includes all elements necessary to achieve the objectives of the plan. It is an indication of the degree that the outputs of the plan are dependent upon the actions of others. Plans that depend upon the actions of others to achieve the desired output do not meet this requirement.
COE authorization guidelines	The federal government has specific guidelines on the types of projects that USACE has authorization to fund. Project must meet the defined project type guidelines as well as meet applicable economic justification criteria for USACE participation.
Levee Design Standards	All levee designs must meet COE standards.

Define Performance Attributes

Performance attributes represent those aspects of a project's scope that may possess a range of potential values. For example, an attribute called "Environmental Impacts" may have a range of acceptable values for a project ranging from 1 acre to 20 acres of wetlands mitigation. It is clear that a concept that offered 15 acres of mitigation would perform at a higher level than one that offered 5 acres, but both would meet the project's need and purpose, and their values (i.e., the relationship between performance and cost) could be rationally compared. Please note that the values assigned to attribute performance were relative to the other alternatives. They were not based on absolute values. The following performance attributes were selected for this project.

Life Safety

This criterion focuses on the potential for life safety risk including the potential for the loss of human life and immediate health impacts that result from flood conditions as well as to facilities such as medical—hospitals, critical care units, helipads for medical; concentrated overnight places– nursing homes, motels; administrative coordination and assistance facilities. It also includes an assessment of the ability to maintain evacuation routes such as road systems leaving major population centers during flood events. Levees with lower geotechnical performance (higher probability of failure prior

to overtopping) were considered to have higher life safety risk due to unexpected failure. A qualitative assessment of life safety was also conducted during the VE study.

Property Damages

This criterion focuses on flood damage benefits which account for the reduction of flood damages to property. Property includes, for example, buildings, economic assets, and loss of standing crops and livestock in agriculture. Each alternative was qualitatively rated based on the geographic distribution of damageable property and the estimated 1/100, 1/200, and 1/500 AEP residual floodplains for the alternative. The analysis was based on a conceptual level of detail.

Critical Infrastructure Damages

This criterion focuses on the potential for impacts to critical infrastructure such as power plants; transportation– road, rail, and air; power– energy supply and distribution systems, including oil; communications– telecommunications network including; public health services– regional healthcare facilities; and water supply and treatment facilities.

Design Capacity Exceedance

Design capacity exceedance measures the remaining flood risks after project measures are constructed that are above and beyond those risks being addressed by the project. This criterion also considers the issue of levee superiority to manage residual risk of catastrophic failures and measures the consequences to life and property if a given alternative's design is exceeded.

Minimize Growth Inducement (Wise Use of Floodplain)

This criterion considers the characteristics of the alternative which could encourage or facilitate growth in the floodplain in an unwise manner. Each alternative was qualitatively rated based on the degree to which the alternative would discourage development in the most high risk areas of the floodplain.

Sustainability

This criterion is a measure of the extent to which future funds and effort will be required to sustain the project measures provided. It is defined as developing and protecting the constructed measures in a manner that enables people to meet current needs and provides that future generations can also meet future needs, from the joint perspective of environmental, economic and community objectives.

Ecosystem Functionality

Ecosystem functionality is a measure of the project's ability to maintain or enhance the natural environment to support a functioning ecosystem. This criterion includes an assessment of the opportunities for riparian and wetland habitat preservation and restoration as well as the efforts to minimize impacts to environmentally sensitive areas adjacent to floodplain such as the riparian forest, oak woodland, and giant garter snake habitats . The criterion also considers the restoration or preservation of natural riverine processes in the floodplain. A wider river channel would also

contribute to improvements in fish habitat. Alternatives should restore and preserve the natural and beneficial values served by flood plains in carrying out its responsibilities.

Minimize Environmental Impacts

This criterion focuses on the project's temporary and permanent impacts to the environment. It includes the preservation of the existing floodplain and avoiding adverse effects on air quality, water quality, and other resources. Land disturbance outside the existing levee footprint should be minimized. The criterion also considers the loss of farmland and impacts to existing structures.

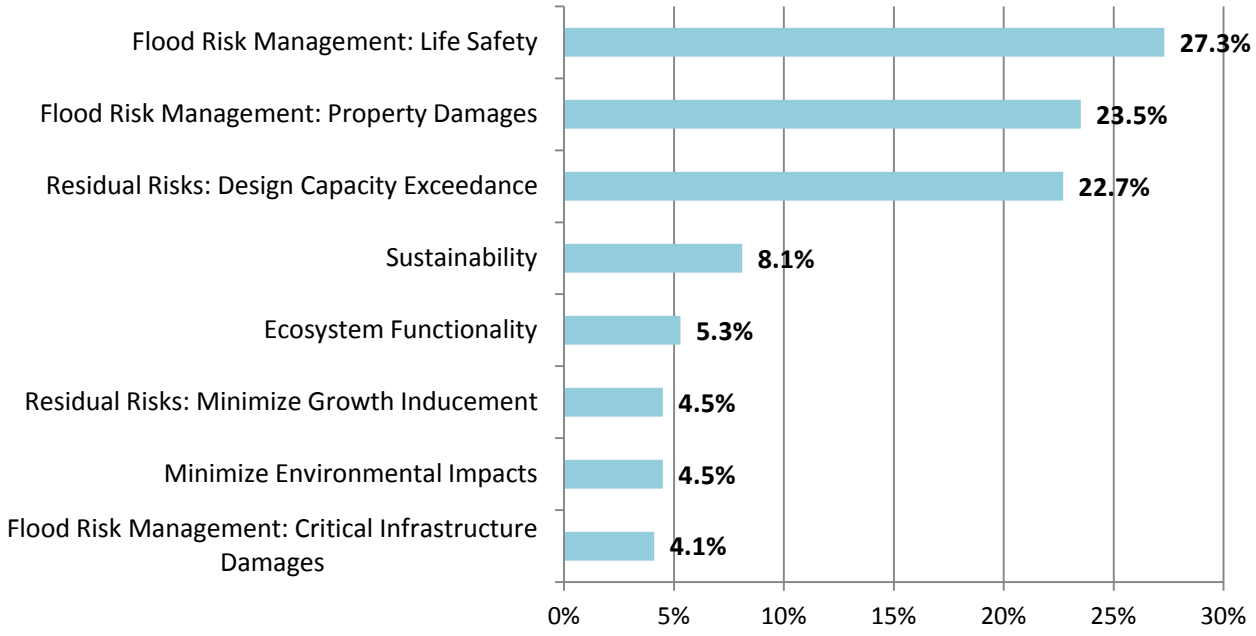
Prioritize Performance Attributes

The performance attributes of a project are seldom of equal importance. Therefore, a systematic approach must be utilized in order to determine their relative importance in meeting the project's need and purpose.

Once the performance attributes were defined and their scales developed, the Project Team and stakeholders prioritized them based on their relative importance to the project. The Analytic Hierarchy Process (AHP) was utilized in the prioritization process. The performance attributes were systematically compared in pairs, asking the question: "An improvement to which attribute will provide the greatest benefit relative to the project's need and purpose?" Participants were then asked to indicate their priorities and the relative intensities of their preferences. The following chart provides the results of this analysis and includes the complete breakdown of the priorities, expressed as a percentage of the whole.

It is important to note that this section describes discussion during the VE study and may not reflect SBFCA, State of California, or USACE policy.

Performance Attribute Prioritization



Performance Attributes Prioritization Rationale

The following information was captured during the performance attribute prioritization process as a means of documenting why a particular attribute was chosen over another and the rationale of the VE Study participants for the priorities indicated above.

Flood Risk Management vs. Residual Risks

Priority is in favor of Flood Risk Management.

Flood risk management is the primary purpose of the project. All alternatives assume a certain level of long-term residual risks, to one level or another. The more that is done under flood risk management, the lower the residual flood risks (but possibly more growth inducement). State floodplain management plans should address growth inducement. The priority still needs to be "fix what is there now". The selected alternative cannot protect people/property outside the project area, and there will be events that will exceed the design that will affect people/property present now. The selected project could provide a lower level of flood risk protection in order to discourage unintended use of land in the future. There is an interest in preserving the rural economy, but this is not fully addressed in the plan where protection of urbanized areas takes priority. By not fixing the levees, for example, one may be unintentionally inducing growth and development in floodplain areas outside the project boundaries.

Flood Risk Management vs. Ecosystem Functionality

Priority is in favor of Flood Risk Management.

Flood risk management is the primary purpose of the project and that ecosystem functionality is a secondary purpose/function. As it relates to life safety, flood risk management takes full priority over ecosystem restoration.

Flood Risk Management vs. Sustainability

Priority is in favor of Flood Risk Management.

Flood risk management is the primary purpose of the project. However, to optimize flood risk management, sustainability must be considered a component of the plan and design. If the alternative does not meet the goal of flood risk management, it does not matter if it is sustainable.

Flood Risk Management vs. Minimize Environmental Impacts

Priority is in favor of Flood Risk Management.

Flood risk management is the primary purpose of the project. Large easements for new or setback levees could be a significant impact to the environment, but would not impede the selection of this approach, if appropriate. In some cases, the socioeconomic impacts need to be considered.

Residual Risks vs. Minimize Environmental Impacts

Priority is in favor of Residual Risks.

All alternatives assume a certain level of long-term residual risks, to one level or another. Each alternative has a very different type and level of residual risks that need to be considered in the alternative selection process. Environmental impacts can be mitigated, especially if unavoidable. Likewise, some residual risks are unavoidable. Economic evaluations of alternatives take into account property damages, etc., but do not account for life loss, which could be significant when associated with the residual risks. Wise use of the floodplain is a basic requirement of the decision making process. This should be addressed by the State Floodplain Management Plan.

Residual Risks vs. Ecosystem Functionality

Priority is in favor of Residual Risks.

The long-term residual risk conditions needs to be of greater importance since the ecosystem is currently performing well. Since the project driver is flood risk management, long-term conditions is a component of such management and should be weighted greater than ecosystem functionality which is supported in conjunction with risk management.

Residual Risks vs. Sustainability

Priority is in favor of Residual Risks.

All alternatives assume a certain level of long-term residual risks, to one level or another. An increase in sustainability should correspond to a reduction in residual risks. In many cases, the project does not have control of residual risks whereas there is control of sustainability. In theory, all levees fail eventually, and there is some control over what will be the residual impact when this event occurs. Additional design components added to a concept could reduce the residual risks, but at additional cost. Also, if an area is outside the protection of the system, it is considered outside of the evaluation of this project. Residual risks relative to property damage are considered in the economic analysis of without project, but not the residual risks associated with life loss.

Ecosystem Functionality vs. Sustainability

Priority is in favor of Sustainability.

Need to have ecosystem functionality in order to have sustainability for future generations. The longevity of the system from an operational point of view, and the need to keep the system operational, is important.

Ecosystem Functionality vs. Minimize Environmental Impacts

Priority is in favor of Ecosystem Functionality.

In general, there is a close balance between the two attributes, where there may be some disturbance of the environment, there would be some benefits to the attributes. But it is better to

minimize damages rather than take aspects from an alternative – that is "do no harm" (which would benefit the ecosystem restoration). There was some opinion that minimizing environmental impacts were really cost issues.

Sustainability vs. Minimize Environmental Impacts

Priority is in favor of Sustainability.

Significant and unavoidable impacts still exist. The level of effort to keep the project operational is paramount, regardless of the impacts to the environment. If the project cannot be sustained, the environmental impacts could be very large.

Sub-attributes under Flood Risk Management

Property Damages vs. Life Safety

Priority between Property Damages and Life Safety is nearly equal, but leans toward Life Safety.

The Corps makes its decision based on the economics of damages. The project must be economically justified. Life safety has not displaced economic considerations. In a post-Katrina world, more emphasis is being placed on life safety, and decisions are being tailored to incorporate life safety to a greater degree. The USACE has made the case of selecting a larger plan with lower net benefits (where the economic NED plan was lower), but it could be justified based on life safety. A levee failure may not have a large life loss impact but property damage could be significant.

Property Damages vs. Critical Infrastructure Damages

Priority is in favor of Property Damages.

Critical infrastructure relates to overall health and welfare of public that is derived from the continued operation of these regional facilities. To some extent, it also impacts life safety (e.g. hospitals, fire protection, etc.). But, the Corps makes its decisions based on economics of damages. The project must be economically justified. Primary drivers of the system are based on National Economic Development (NED) decisions using the other factors as modifiers to enhance the NED.

Life Safety vs. Critical Infrastructure Damages

Priority is in favor of Life Safety.

Both are modifiers of property damage (NED decision), but life safety is a more important modifier.

Sub-attributes under Residual Risks

Minimize Growth Inducement vs. Design Capacity Exceedance

Priority is in favor of Design Capacity Exceedance.

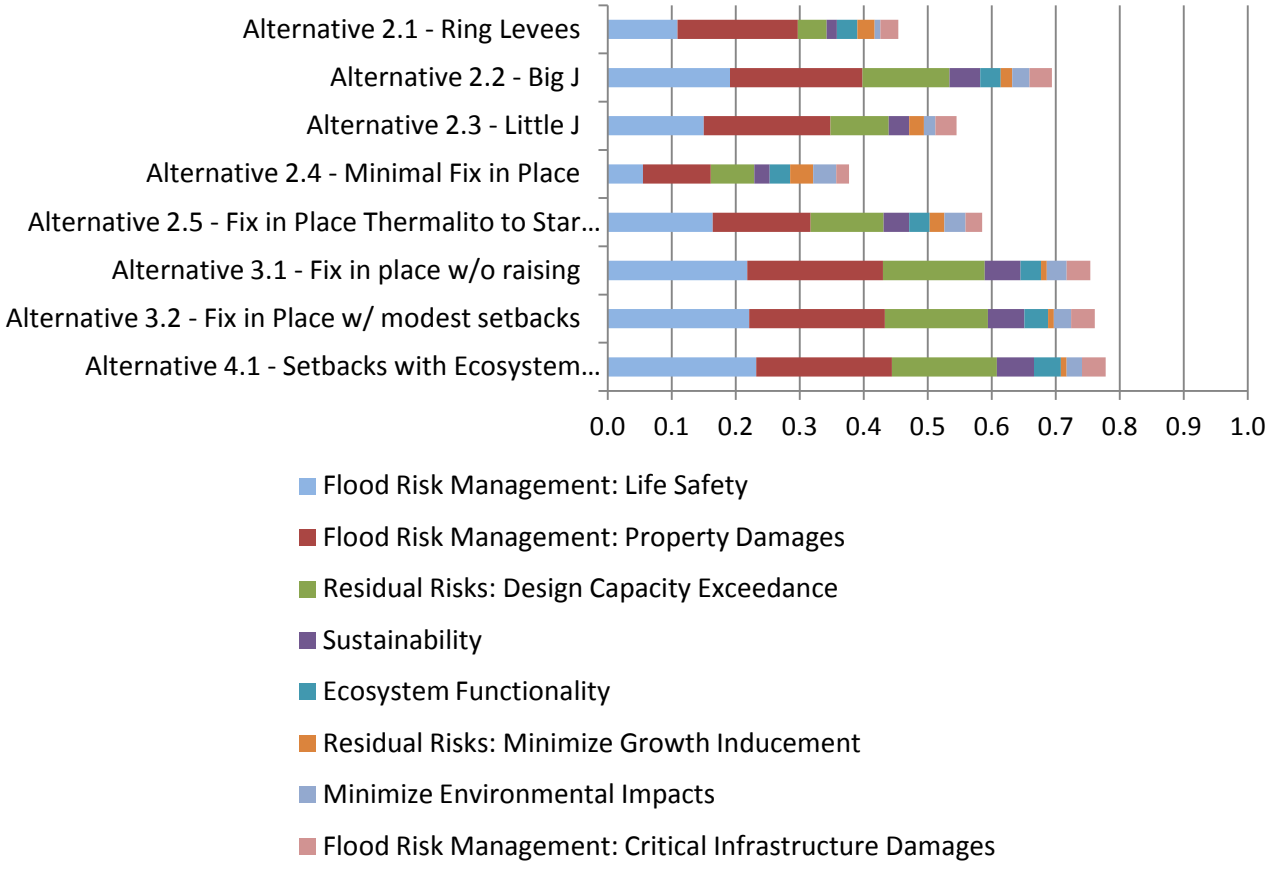
Unwise use of land includes growth inducement. Unprotected life and property is that which remains in areas that are outside the protected areas within the project boundaries. "If you build it, they will

come", but this can be controlled by zoning and floodplain ordinances. It does little good to address a problem in the short term that becomes a bigger problem in the long term. The long term effects represented by the damage caused by an event above and beyond the design capacity should be more important. SB 5 would not allow unwise use of floodplain land in urban or urbanizing areas. But if the 1/200 level of flood protection is constructed, there would no longer be a requirement to prevent growth in the area. Within protected areas, added residual risks can also be experienced from added development as well as flood events that exceed the design.

Measure Performance of Baseline Concepts

The project team and stakeholders evaluated the performance of the Baseline Concepts relative to performance attributes described above. The total performance scores reflect the performance rating for each attribute multiplied by its overall priority (weight) expressed using a ratio scale. A total performance score of "1" would indicate the highest level of desired performance (i.e., "ideal" performance). The chart below compares the total performance scores for the Baseline Conceptual Alternatives.

Comparison of Performance



The information below reflects the performance ratings and associated rationale for each attribute.

RING LEVEES ALTERNATIVE (Alternative 2.1)

Cost

The total estimated first cost of this alternative is $582 to 1,248 million. A breakdown of approximate first cost for each ring levee is provided below.

Measure S1 (Biggs Ring Levee): $60 to $129 million
Measure S2 (Gridley Ring Levee): $95 to $204 million
Measure S3 (Live Oak Ring Levee): $82 to $177 million
Measure S4 (Yuba City Ring Levee): $313 to $671 million

Life Safety

This alternative would reduce flood risk for a majority of the concentrated population and property within Yuba City, Live Oak, Gridley, and Biggs. Locations outside of the ring levees (non-urban areas) would not receive flood reduction benefits from the ring levees. However, these areas are relatively low in population density. The ring levee around Yuba City would include a reach of the Feather River levee system. Thus, there would only be one line of protection around Yuba City versus two lines of protection provided by the ring levees of the other communities. A drawback of this alternative is that ring levees would rely on flood gates and other measures at crossings with railroads and roadways that would need to be actively operated in order to be effective. This alternative would also require access to evacuation routes. An evacuation plan would be included as a nonstructural measure for this alternative to address life safety.

Property Damages

This alternative provides flood risk reduction to key urban development areas, thus property damages from flood events would be minimized. The ring levees around the four urbanized communities would reduce the flood risk for much of the property within the study area. However, some agricultural and some rural structures would still be exposed to flood risk. Based on estimated net benefits, Yuba City is the only potentially economically justified increment.

Critical Infrastructure Impacts

Ring levees would reduce flood risk for key regional facilities and other critical infrastructure within the ring levees, but would not reduce the risk of flooding of roadways and railroads outside of the ring levees.

Design Capacity Exceedance

If design capacity was exceeded, the interior of the ring levees would flood rapidly, which could result in loss of life. In addition, the ring levee around Yuba City would include a reach that is part of the

Feather River levee system. Thus, there would be only one line of protection for Yuba City versus two layers from the ring levees of the other three communities.

Minimize Growth Inducement (Wise Use of Floodplain)

This alternative would limit growth of local communities and future regional growth, while allowing in-fill and redevelopment within the existing developed area.

Sustainability

This alternative would require maintenance of pump stations and closure structures to ensure effective continued operation and flood risk management for the ring levees. In addition, this alternative would require maintaining the existing levees within the study area, which are currently at risk of failure due to through-seepage and underseepage. Maintenance of new ring levees would also be required. However, the maintenance requirements of new levees would be less than existing levees because they would be constructed on new foundations and to modern engineering standards.

Ecosystem Functionality

Opportunities may exist for ecosystem restoration near the reaches of levee at Yuba City that would be incorporated into the Yuba City ring levee. There are few opportunities for ecosystem restoration associated with the other ring levee locations. Constructing new ring levees may impact existing functionality.

Minimize Environmental Impacts

This alternative preserves the existing floodplain while minimizing the potential for future growth and associated adverse effects on air quality and other resources. However, this alternative has the potential to conflict with local land use plans. Construction of the ring levees would require multiple railroad crossings as well as crossings of two significant drainage canals in Yuba City. Significant borrow material would be required for construction of the new levees. Direct and indirect impacts associated with this alternative could affect environmentally and culturally sensitive areas. In addition, construction of the levees would occur in urban areas that are more susceptible to air and noise quality impacts. Ring levees would also separate the communities of Yuba City, Live Oak, Gridley, and Biggs from their surrounding supporting areas and would result in aesthetic impacts by disrupting existing viewsheds. Pump stations would have to be operated periodically, which may result in air quality and noise impacts. There may also be HTRW issues associated with new levee alignments.

BIG "J" LEVEE ALTERNATIVE (Alternative 2.2)

Cost

The total estimated first cost of this alternative is $703 to $1,506 million.

Life Safety

This alternative would reduce flood risk to the majority of the population and property within the study area. Areas in the southern portion of the study located below the Big "J" cross-levee would be located within the 1/100 AEP floodplain. No actively operated closures would be necessary to maintain this alternative. All existing evacuation routes would be maintained.

Property Damages

This alternative would capture approximately 93% of total benefits within the study area. However, some agricultural and some rural structures would still be exposed to flood risk. The benefits would be limited by the performance of the Sutter Bypass levees, which have a lower performance than the Feather River levees.

Critical Infrastructure Impacts

This alternative would provide flood risk reduction for hospitals, power plants, and other critical infrastructure within the study area, but would not reduce risk for all critical roadways within study area limits.

Design Capacity Exceedance

If design capacity was exceeded, the evacuation route on westbound Route 20 would be impacted. Flood depths would be greater due to the height of the southern cross levee south of Yuba City. The flood depths within the urbanized area of Yuba City would increase at a faster rate due to changes in the location of floodplain storage. Areas in the southern portion of the study area (below Sutter Bypass levee) would remain at high risk to flooding.

Minimize Growth Inducement (Wise Use of Floodplain)

This alternative reduces flood risk in Yuba City and other communities, which would allow for growth in existing urbanized areas. The cost of complying with the floodplain regulations could limit growth in the study area outside the Big J levee.

Sustainability

This alternative would result in reduced maintenance on the majority of existing levees along the Feather River, which are currently at risk of failure due to through-seepage and underseepage. New cross-levees for this alternative would be constructed on new foundations and to modern engineering standards. In addition to the maintenance required for the existing levees, these new reaches would require additional maintenance.

Ecosystem Functionality

Opportunities exist for ecosystem restoration within the segments of this alternative that include existing levees. There are few opportunities for ecosystem restoration on other segments of this

alternative. Constructing cross-levees may invade existing functioning ecosystems. Preserving existing levees may allow for future ecosystem restoration projects.

Minimize Environmental Impacts

Construction of the new cross levee associated with this alternative would directly impact farmland and potential sensitive habitat areas. Construction impacts would be limited where land disturbance is confined to existing levee footprints. Seepage berms, canal relocations, and land requirements could impact adjacent environmentally sensitive habitats and structures. The alternative would also require crossing two significant drainage culverts in Yuba City and significant borrow material to construct new levee reaches. Construction of cutoff walls could potentially disrupt groundwater flows. Potential HTRW issues exist for new levee alignments. The alternative would include construction of levee reaches in urban areas, which are more susceptible to air and noise quality impacts. These new levee reaches would result in aesthetic impacts by disrupting existing viewsheds. This alternative would also separate the agricultural areas in the southern portion of the study area from the communities located in the northern portion.

LITTLE "J" LEVEE ALTERNATIVE (Alternative 2.3)

Cost

The total estimated first cost of this alternative is $560 to $1,201 million based on a reconnaissance level of detail.

Life Safety

This alternative would reduce flood risk to the majority of the population and property within the study area due to the population density in Yuba City. Areas in the southern portion of the study located below the Little "J" cross-levee would remain at risk of flooding. This alternative would impact the evacuation route on westbound Route 20 and two major drainage areas in Yuba City.

Property Damages

This alternative would capture approximately 93% of total benefits within the study area. However, some agricultural and some rural structures would still be exposed to flood risk.

Critical Infrastructure Impacts

This alternative reduces the risk of flooding for hospitals, power plants, and other critical infrastructure within the study area, but does not reduce risk for certain roadways within project limits.

Design Capacity Exceedance

If design capacity was exceeded, the evacuation route on westbound Route 20 and two major drainage areas in Yuba City would be impacted. Areas in the southern portion of the study area

(below Sutter Bypass levee) would remain at risk to flood. The area north of the Little "J" levee would capture flood waters from the breach resulting in greater depths and faster stage increases.

Minimize Growth Inducement (Wise Use of Floodplain)

This alternative reduces flood risk in Yuba City and other communities, which would allow for growth in existing urbanized areas. It provides limited flood risk reduction in all other parts of the study area, which could limit future growth. It focuses development in areas designated or already developed in lieu of encouraging development scattered through floodplain.

Sustainability

This alternative would result in reduced maintenance on the majority of existing levees along the Feather River, which are currently at risk of failure due to through-seepage and underseepage. New cross-levees for this alternative would be constructed on new foundations and to current engineering standards. In addition to the maintenance required for the existing levees, the new levee reaches would require additional maintenance. This alternative would also require maintenance of pump stations and closure structures to ensure effective continued operation and flood risk management.

Ecosystem Functionality

Opportunities exist for ecosystem restoration within the reaches of this alternative that include existing levees. There are few opportunities for ecosystem restoration on other reaches of this alternative. Constructing cross-levees may invade existing functioning ecosystems. Preserving existing levees may allow for future ecosystem restoration projects.

Minimize Environmental Impacts

Construction of the new cross levee associated with this alternative would directly impact farmland and potential sensitive habitat areas. Construction impacts would be limited if land disturbance is confined to existing levee footprints. Seepage berms, canal relocations, and land requirements could impact adjacent environmentally sensitive habitats and structures. The alternative would also require crossing two significant drainage systems in Yuba City and significant borrow material to construct levee reaches. Construction of cutoff walls could potentially disrupt groundwater flows. Potential HTRW issues exist for new levee alignments. The alternative would include construction of levee reaches near urban areas, which are more susceptible to air and noise quality impacts. These new levee reaches would result in aesthetic impacts by disrupting existing viewsheds. This alternative would also separate the agricultural areas in the southern portion of the study area from the communities located in the northern portion.

MINIMAL FIX-IN-PLACE ALTERNATIVE (Alternative 2.4)

Cost

The total estimated first cost of this alternative is $177 to $381 million based on a reconnaissance level of detail.

Life Safety

This alternative would reduce flood risk to some portions of Yuba City and surrounding areas, but would not reduce flood risk for the communities in the northern study area (Live Oak, Gridley, and Biggs) and some portions of Yuba City. This alternative addresses high life risk areas south of the Yuba River and Feather River confluence and in Yuba City. In the event of flooding, the eastbound SR-20 evacuation route would be accessible, but evacuation routes SR-99 and Westbound SR-20 would be cut off.

Property Damages

This alternative would provide flood risk reduction to approximately half of Yuba City, which includes approximately 77% of the total property within the study area. It would provide some protection to agricultural lands. The alternative would capture approximately 29% of total benefits within the study area. Compared to the other structural alternatives, it would provide the least amount of flood risk reduction and expose the maximum amount of property to potential damage.

Critical Infrastructure Impacts

The alternative would not provide flood risk reduction for all key critical infrastructure (hospitals, power plants) and would not provide flood risk reduction for roadways or railroads within the study area.

Design Capacity Exceedance

Given the limited extent of levee improvements, it is anticipated that design capacity would be exceeded on a frequent basis. In the event of flooding, the eastbound SR-20 evacuation route would be accessible, but evacuation routes SR-99 and Westbound SR-20 would be cut off. The alternative would not result in the ponding issues caused by the cross-levees in the J-levee alternatives.

Minimize Growth Inducement (Wise Use of Floodplain)

This alternative reduces flood risk in approximately half of Yuba City. It does not provide flood risk reduction in all other parts of the study area, which could limit future growth.

Sustainability

Compared to the other structural alternatives, this alternative would result in the minimum amount of existing levees being improved. Thus, maintenance efforts for existing levees would be greater as compared to the other alternatives. It is assumed that new or improved levees constructed to current standards will require less maintenance than existing levees. However, the alternative would not add any additional reaches of levees to be maintained.

Ecosystem Functionality

Opportunities exist for ecosystem restoration along existing levees. Preserving existing levees may allow for future ecosystem restoration projects.

Minimize Environmental Impacts

Construction impacts would be limited if land disturbance is confined to existing levee footprints. Seepage berms, canal relocations, and land requirements could impact adjacent environmentally sensitive habitats and structures. Construction of cutoff walls could potentially disrupt groundwater flows.

FIX-IN-PLACE THERMALITO TO STAR BEND ALTERNATIVE (Alternative 2.5)

Cost

The total estimated first cost of this alternative is $422 to $905 million based on a reconnaissance level of detail.

Life Safety

This alternative would provide a consistent level of flood risk reduction to northern areas and communities within the study area, including Yuba City. It would not provide flood risk reduction from an event in the western portion of the study area. Due to the downstream levee height and its impacts on backwaters, there is an inflection point on improving the levees to address life safety south of Star Bend. This alternative would preserve eastbound SR-20 as an evacuation route, but would cut off SR-20 westbound and SR-113 as evacuation routes.

Property Damages

The alternative would capture approximately 79% of total benefits within the study area. However, some agricultural and some rural structures would still be exposed to flood risk.

Critical Infrastructure Impacts

This alternative would reduce risk for the majority of hospitals, power plants, and other critical infrastructure within the study area, but would not reduce risk for certain roadways.

Design Capacity Exceedance

It is anticipated that design capacity would be exceeded on a frequent basis. However, the levees along the northern segments of the Feather River would be improved and the probability of potential breaches would decrease. This alternative would preserve eastbound SR-20, but would cut off SR-20 westbound and SR-113 as evacuation routes. The alternative would not result in the ponding issues caused by the cross-levees in the J-levee alternatives. However, deep ponding in the southern portion of the study area would exist.

Minimize Growth Inducement (Wise Use of Floodplain)

This alternative would provide flood risk reduction to a significant portion of study area, thus removing flood risk as an obstacle to future regional growth and development in these areas. By reducing risk to the existing urbanized areas, it focuses development in areas designated or already developed in lieu of encouraging development scattered through floodplain.

Sustainability

This alternative would improve reaches of existing levees that currently have issues related to underseepage and through-seepage, thus reducing maintenance requirements. The alternative would not add any additional levees to be maintained. The Sutter Bypass levees and Feather River levees below Star Bend would not be improved and maintenance requirements are anticipated to remain the same.

Ecosystem Functionality

Opportunities exist for ecosystem restoration along existing levees. Preserving existing levees may allow for future ecosystem restoration projects.

Minimize Environmental Impacts

Construction impacts would be limited if land disturbance is confined to existing levee footprints. Seepage berms, canal relocations, and land requirements could impact adjacent environmentally sensitive habitats and structures. Construction of cutoff walls could potentially disrupt groundwater flows.

FIX-IN-PLACE WITHOUT RAISING ALTERNATIVE (Alternative 3.1)

Cost

The total estimated first cost of this alternative is $737 to $1,579 million based on a reconnaissance level of detail.

Life Safety

This alternative would provide flood risk reduction to most of the study area, including Yuba City, Live Oak, Gridley, and Biggs. In comparison to the previous alternatives, it would also reduce flood risk in the southern part of the study area. However, it would not provide flood risk reduction from an event in the western portion of the study area. This alternative would preserve SR-20 and SR-113 as evacuation routes.

Property Damages

The alternative would capture most of the total benefits within the study area. However, some agricultural and some rural structures would still be exposed to flood risk.

Critical Infrastructure Impacts

The alternative would reduce risk for hospitals, power plants, and other critical infrastructure as well as roadways and railroads within the study area.

Design Capacity Exceedance

This alternative would provide flood risk reduction to most of the study area. Flooding from an event that exceeded the design capacity would be similar to the existing (without-project condition). This alternative would preserve SR-20 and SR-113 as evacuation routes.

Minimize Growth Inducement (Wise Use of Floodplain)

This alternative would provide flood risk reduction to a significant portion of study area, thus removing flood risk as an obstacle to future regional growth and development to these areas. However, existing building codes and land use restrictions could limit future growth.

Sustainability

This alternative would improve the majority of reaches of existing levees, thus reducing maintenance requirements. The alternative would not add any additional levees to be maintained.

Ecosystem Functionality

Opportunities exist for ecosystem restoration along existing levees. Preserving existing levees may allow for future ecosystem restoration projects.

Minimize Environmental Impacts

Construction impacts would be limited if land disturbance is confined to existing levee footprints. Seepage berms, canal relocations, and land requirements could impact adjacent environmentally sensitive habitats and structures. Construction of cutoff walls could potentially disrupt groundwater flows.

PRIMARILY FIX-IN-PLACE W/ MODEST SETBACKS ALTERNATIVE (Alternative 3.2)

Cost

The total estimated first cost of this alternative is $882 to 1,900 million based on a reconnaissance level of detail.

Life Safety

This alternative would provide flood risk reduction to most of the study area, including Yuba City, Live Oak, Gridley, and Biggs. It would reduce flood risk in the southern part of the study area, but would not provide flood risk reduction from an event in the western portion of the study area. This

alternative would preserve SR-20 and SR-113 as evacuation routes. Setback levees would reduce the water surface elevation. There would be a marginal factor of safety improvements due to setback levees being built on new foundations.

Property Damages

The alternative would capture almost 100% of total benefits within the study area. However, some agricultural and some rural structures would still be exposed to flood risk.

Critical Infrastructure Impacts

The alternative would reduce risk for hospitals, power plants, and other critical infrastructure as well as roadways and railroads within the study area.

Design Capacity Exceedance

This alternative would provide flood risk reduction to most of the study area. It would not create the ponding issue that would be caused by the cross-levees of the Big "J" and Little "J" alternatives and would provide more area for ponding in the southern portion of the study area. In comparison to the previous alternatives, it would also reduce flood risk in the southern part of the study area. However, it would not provide flood risk reduction from an event in the western portion of the study area. This alternative would preserve SR-20 and SR-113 as evacuation routes. Setback levees would allow levees to withstand erosion during design exceedance better than fixing the existing levees in place.

Minimize Growth Inducement (Wise Use of Floodplain)

This alternative would provide flood risk reduction to a significant portion of study area, thus removing flood risk as an obstacle to future regional growth and development to these areas. However, existing building codes and land use restrictions could limit future growth.

Sustainability

This alternative would improve the majority of reaches of existing levees, thus reducing maintenance requirements. Setback levees would be constructed on new foundations and to latest engineering standards, thus reducing maintenance efforts. Setback levees would have access points and distances to allow maintenance vehicles access.

Ecosystem Functionality

Levee setbacks would create opportunities for restoration of riparian and wetland habitats within the setback areas (approximately 700 acres). A wider river channel would contribute to improvements in fish habitats.

Minimize Environmental Impacts

Construction impacts would be limited if land disturbance is confined to existing levee footprints. Seepage berms, canal relocations, and land requirements could impact adjacent environmentally sensitive habitats and structures. Construction of cutoff walls could potentially disrupt groundwater flows. Where setback levees are proposed, construction may require removal or relocation of structures and include conversion of farmland to upland, riparian or wetland habitats.

SETBACKS WITH ECOSYSTEM RESTORATION ALTERNATIVE (Alternative 4.1)

Cost

The total estimated first cost of this alternative is $1,543 to $3,308 million based on a reconnaissance level of detail.

Life Safety

This alternative would provide flood risk reduction to most of the study area, including Yuba City, Live Oak, Gridley, and Biggs. It would reduce flood risk for most of the study area. This alternative would preserve SR-20 and SR-113 as evacuation routes. Setback levees would reduce the water surface elevation. There would be a marginal factor of safety improvement due to setback levees being built on new foundations.

Property Damages

The alternative would capture almost 100% of total benefits within the study area. However, some agricultural and some rural structures would still be exposed to flood risk.

Critical Infrastructure Impacts

The alternative would reduce risk for hospitals, power plants, and other critical infrastructure as well as roadways and railroads within the study area.

Design Capacity Exceedance

This alternative would provide flood risk reduction to most of the study area. It would not create the ponding issue that would be caused by the cross-levees of the Big “J” and Little “J” alternatives and would provide more area for ponding in the southern portion of the study area. In comparison to the previous alternatives, it would also reduce flood risk in the southern part of the study area. However, it would not provide flood risk reduction from an event in the western portion of the study area. This alternative would preserve SR-20 and SR-113 as evacuation routes. Setback levees would allow levees to withstand erosion during design exceedance better than fixing the existing levees in place.

Minimize Growth Inducement (Wise Use of Floodplain)

This alternative would provide flood risk reduction to a significant portion of study area, thus removing flood risk as an obstacle to future regional growth and development to these areas. However, existing building codes and land use restrictions could limit future growth.

Sustainability

This alternative would improve the majority of existing levees, thus reducing maintenance requirements. Setback levees would be constructed on new foundations and to latest engineering standards, thus reducing maintenance efforts. Setback levees would have access points and distances to allow maintenance vehicles access.

Ecosystem Functionality

Levee setbacks would create opportunities for restoration of riparian and wetland habitats within the setback areas (approximately 4,100 acres). A wider river channel would contribute to improvements in fish habitats.

Minimize Environmental Impacts

Construction impacts would be limited if land disturbance is confined to existing levee footprints. Seepage berms, canal relocations, and land requirements could impact adjacent environmentally sensitive habitats and structures. Construction of cutoff walls could potentially disrupt groundwater flows. Where setback levees are proposed, construction may require removal or relocation of structures and include conversion of farmland to upland, riparian, and wetlands habitats.

Compare Value

The cost elements were compared and normalized for the Baseline Conceptual Alternatives using the following table. The table illustrates how cost scores were derived. In this comparison, a lower score is desirable as the project will benefit from lower costs.

Strategies	Cost	Score
Alternative 2.1 - Ring Levees	$853,900,000	0.101
Alternative 2.2 - Big J	$1,070,900,000	0.126
Alternative 2.3 - Little J	$839,200,000	0.099
Alternative 2.4 - Minimal Fix in Place	$267,000,000	0.031
Alternative 2.5 - Fix in Place Thermalito to Star Bend	$651,800,000	0.077
Alternative 3.1 - Fix in place w/o raising	$1,157,400,000	0.136
Alternative 3.2 - Fix in Place w/ modest setbacks	$1,376,900,000	0.162
Alternative 4.1 - Setbacks with Ecosystem Restoration	$2,273,500,000	0.268
TOTAL	**$8,490,600,000**	**1.000**

Once relative scores for performance and cost have been derived, the next step is to synthesize a value index for the Baseline Conceptual Alternatives. The basic equation for value is:

$$Value = \frac{Performance}{Cost + Time}$$

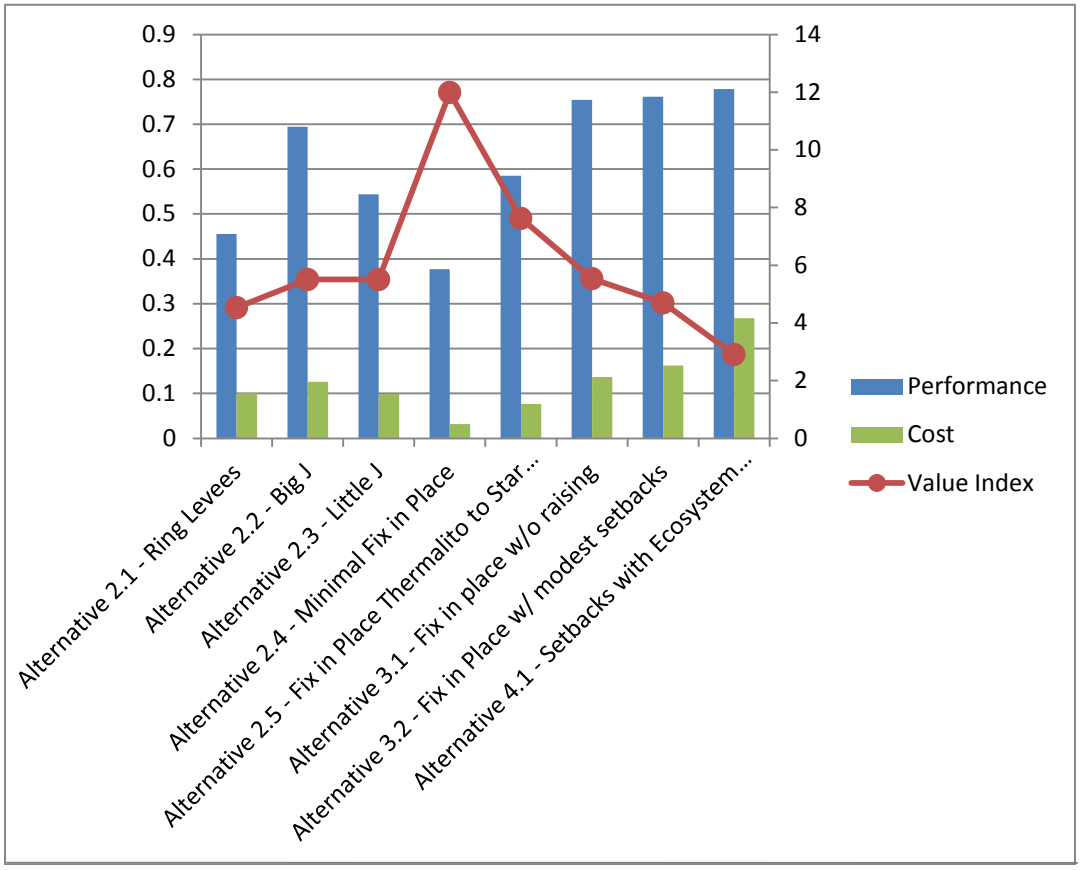
A Value Matrix was prepared which facilitated the comparison of the Baseline Conceptual Alternatives by organizing and summarizing this data into a tabular format. The performance scores for each alternative were divided by the total cost scores for each alternative to derive a value index.

Value Matrix

Baseline Conceptual Alternatives

Strategies	Performance Score	Cost/Time Score	Value Index
Alternative 2.1 - Ring Levees	0.456	0.101	4.529
Alternative 2.2 - Big J	0.694	0.126	5.504
Alternative 2.3 - Little J	0.544	0.099	5.505
Alternative 2.4 - Minimal Fix in Place	0.377	0.031	11.989
Alternative 2.5 - Fix in Place Thermalito to Star Bend	0.585	0.077	7.622
Alternative 3.1 - Fix in place w/o raising	0.754	0.136	5.535
Alternative 3.2 - Fix in Place w/ modest setbacks	0.761	0.162	4.693
Alternative 4.1 - Setbacks with Ecosystem Restoration	0.778	0.268	2.906

Comparison of Value – Baseline Conceptual Alternatives



VALUE ENGINEERING

VALUE ENGINEERING

This section documents the Creativity, Evaluation, and Development phases of the VE Study.

CREATIVE IDEA SPECULATION

The VE team generated and evaluated ideas on how to perform the various project functions using other approaches. All of the ideas that were generated during the Speculation Phase using brainstorming techniques were recorded and are included at the end of this section.

VE CONCEPTS

The ideas that the VE team considered of highest potential for value improvement or further consideration are presented as VE Concepts. Each VE Concept consists of a brief description of the suggested change and a narrative comparing the baseline concept with the VE Concept. Given this study was conducted at an early stage of project development, the VE Concepts generated are of a conceptual nature and focus primarily on optimization of the Baseline Conceptual Alternatives array through either incorporating additional flood risk reduction measures and/or modifying the Conceptual Alternatives per lessons learned during the previous workshop exercises (Function Analysis and Value Metrics). The VE team also identified suggested revisions to the Baseline Conceptual Alternative array through the combination of certain alternatives or the elimination of alternatives from further consideration.

VE CONCEPTS SUMMARY

Summary of VE Concepts

VE Concept No. & Description	Disposition	Disposition Comments
Refinement of Measures		
A-1 Adopt State's floodplain development regulations (wise use of floodplain)	Further Study Needed	PDT to review SB-5 for clarification on regulations. Make part of Without Project Conditions or revise project per regulations. Does it have enough teeth to prevent future development or do additional regulations need to be enacted in the Federal Government preferred plan?
A-2 Establish pre-stage flood fighting areas and equipment	Accept	Add as Measure (NS-9) under each Conceptual Alternative
A-3 Coordinate emergency responses to all floodplain (in lieu of by county)	Accept	Revise NS-6 and NS-7 per VE Concept

VE Concept No. & Description	Disposition	Disposition Comments
A-4 Exempt slurry walls from 408 certification process	Further Study Needed	Local sponsor to propose revision of 408 process to USACE
Modifications to Preliminary Conceptual Alternatives		
M-1 Construct ring levee around Yuba City only in lieu of around other urbanized communities	Accept	Alternative 2.1 to be revised and reevaluated accordingly. PDT to identify non-structural measures required for areas not being provided with ring levees.
M-2 Construct evacuation routes for ring levee alternative	Accept	Yuba City has evacuation routes for the ring levee alternative, but these may need to be upgraded or improved to function as evacuation during failure of the ring levee. Consider high ground refuges may function in lieu of evacuation routes.
M-3 Add S-15 (southern relief feature) to Alternatives 2.2, 2.3, 2.4, 2.5	Accept	Concept to be reviewed as an optional supplemental measure to subject Alternatives
M-4 Add measure for Fix in Place for Sutter Triangle area	Accept / Further Study Needed	PDT to review cost of measure. Consider for optional supplemental measure (S-28) for Alternatives 3.1 and 2.2
M-5 Construct hydraulic elevation control in southern part of basin to prevent certification of southern segment levees to 200 years.	Further Study Needed	Hydraulic control already exists for current levee elevations.

Revise Conceptual Alternatives Array		
R-1 Implement non-structural measures across all structural alternatives in lieu of holding independent non-structural alternative	Already Being Done	PDT to review new Alternative 1.2 (Minimal Fix in Place with Non-Structural Measures) to determine scope of work for non-structural measures to evaluate the new alternative.
R-2 Combine Alternative 3.1 and Alternative 3.2 and evaluate as single alternative	Accept	Modest setbacks become optional separate optimizations of Alternative 3.1.
R-3 Eliminate Alternative 4.1 from future consideration	Accept	Concur.
R-4 Revise Alternative 2.1	Accept	Alternative 2.1 to be revised to ring levee around only Yuba City. PDT to identify non-structural measures required for communities not being provided with ring levees.
R-5 Combine Alternative 2.4 with Alternative 2.1 (Nonstructural)	Accept	PDT to review new alternative (Minimal Fix in Place with Non-Structural Measures) to determine scope of work for non-structural measures to evaluate the new alternative.

Revise Conceptual Alternatives Array		
R-6 Eliminate Alternative 2.2 Big J from consideration	Accept	It was recommended that the Big "J" levee be eliminated from further evaluation based on a comparison with the Little “J” levee, which are functionally similar. The Big "J" levee and the Little “J” levee are expected to have similar flood damage benefits. However, the Big “J” levee would be approximately 30% greater in cost based on conceptual cost estimates. Additionally, the benefits associated with the Big “J” levee would be limited by the performance of the Sutter Bypass levees, which have a lower performance than the Feather River levees. The Little “J” levee does not utilize the Sutter Bypass levees and can therefore obtain a higher level of performance. Finally, if the design capacity of the Sutter Bypass reach of the Big “J” levee was exceeded, flood depths would be greater than existing conditions due to the height of the southern cross portion of the “J” levee (south of Yuba City). The flood depths would also increase at a faster rate due to less floodplain storage.

VE CONCEPTS DEVELOPMENT

The following sections include the narrative development of the VE Concepts as they were developed by the VE team. The narratives are provided for the additional information and understanding of the reviewer relative to each idea and are independent of their respective dispositions. After developing the VE Concepts, the VE team reviewed and discussed each VE Concept and developed a consensus relative to its implementation. In some cases, the latter discussion resulted in dispositions of "Further Study Needed" or Rejection of certain concepts altogether. As such, some concepts included below were not implemented into the project's development, but are included for information purposes only. The disposition decision of each VE Concept as determined by the VE Team is provided in the preceding table.

REFINEMENT OF MEASURES

A-1 Adopt State floodplain development regulations (wise use of floodplains). Institute state and local ordinances to avoid floodplain development

The State of California has adopted SB-5 which limits development in areas without 200-year level of protection, and is in accordance with FEMA regulations. The State and local government also have restrictions on floodplain development within Title 24 (California Building code). If the Corps selected plan provides less than 200-year protection to areas with deep flooding depths (e.g. south of Yuba City), the result would be that State law would prevent additional development in the deeper portions of the floodplain, allowing the Corps to address the wise use of floodplains directed by E.O. 11988.

A-2 Establish stage flood fighting areas and equipment

One or more secured area will be identified and stocked with appropriate flood fighting supplies, including lighting, flares, and equipment to allow working at night. Stockpiles of geotextile fabric, sand for fill, and rip-rap of various sizes must be available. The following should also be considered:

- A rapid flood fighting response cache including trained local response force capable of containing a levee breach.
- Coordinated communications efforts with California National Guard and local law enforcement must be planned for and accomplished for traffic control during evacuation.
- Coordination with local and state emergency response authorities to evacuate immediate area needs to be in place.
- USACE must assure that these measures have been planned, documented and exercised for this feasibility study.
- Reduce response time hence improve performance level (lower damages and life loss when failure occurs).

A-3 Coordinate emergency responses to all floodplain (in lieu of by county)

Emergency response will include evacuation authority directives. The flood warning system will be coordinated with Butte and Sutter Counties. A coordinated response protocol directed for information dissemination will be developed and exercised between city EMS, county EMS and State EMS offices. Appropriate decision makers will be identified and documented at the city, county, regional, state, and federal levels. Direct lines of communication will be established with decision makers to assure prompt response effort. Response operation orders will be established, and assignments and responsibilities in order to direct residents and non-residents to the most appropriate evacuation routes. USACE will assure the presence and adequacy of local, emergency response plans and assure that coordination has occurred with state and federal counterparts.

A-4 Exempt slurry walls from 408 certification process

Exempting slurry walls from the Section 408 process implies that the modifications would be reviewed under the Section 208 process. The distinction between Section 208 and 408 is that for a project to be modified under 208, it must not change hydraulics or the structural geometry of the levee, and approval of the 208 may be made by the District Engineer, otherwise approval at HQ level is required. The result would be potentially lower costs to the sponsor in form reduced effort of review by the Corps. Changes to the process require changes in USACE policy; the ability to affect change is beyond the scope of the PDT effort, and likely does not affect the selection of alternatives.

MODIFICATIONS TO PRELIMINARY CONCEPTUAL ALTERANTIVES

M-1 Construct Ring Levee around Yuba City 'only' in lieu of around other urbanized communities

Early parametric analysis leads to preliminary conclusion that smaller rings around Biggs, Gridley and Live Oak are not economical in comparison to the ring levee around Yuba City.

M-2 Construct evacuation routes for ring levee alternative

Ring levees are likely to be perceived by the public as 'refuge' areas and are not likely to be evacuated before a mainstem levee break. Therefore, confined populations are trapped within the rings so at least one evacuation route or high-ground 'refuge' should be included within the ring levee alternative. Several measures have been proposed for this purpose including Hwy 99 Causeway which links all the rings, widened ring levees to serve as high-ground 'refuge', elevated 'critical' structures, and various rescue mechanisms. This alternative is unacceptable without this evacuation route as a 'failure' of the ring levee would quickly inundate the ring and the resulting loss of life would be unacceptable.

M-3 Add Measure S-15 (southern relief structure) to Alternatives 2.3, 2.4 & 2.5

The unimproved portions of the levees under these alternatives would still be subject to levee failure, causing deep flooding in the southern portion of the study area. A Relief Structure or Emergency Relief Mechanism could help relieve both stage and duration of deep ponding (20'+).

M-4 Add measure for Fix-in-Place for Sutter Triangle Area

The Right Bank, Wadsworth Canal and Left Bank, Sutter Bypass protect parts of the small town of Sutter. This measure would reduce flood impacts in that area. The area is also subject to flood risks from the Northern Feather River levee breaks. Other measures would address the Feather River Levee Improvements, however, this measure is necessary to protect this area from adjacent levee failures.

M-5 Construct Hydraulic Elevation Control in the Southern part of the basin to prevent/preclude certification of Southern segment levees to 200 years

The southern portion of the basin is agricultural at present and subject to deep flooding. Wise use of the floodplain could be facilitated by improving the levees to less than a 200-year level of protection. State law (SB-5) precludes urbanization in areas where there is less than 200-year level of protection after 2015. Additional local land-use restrictions may also be required to meet this objective.

REVISED CONCEPTUAL ALTERNATIVE ARRAY

R-1 Combine Alternatives 3.1 and 3.2

This new alternative would combine 3.1 (Fix in place without raising) with 3.2 (Primarily fix in place including modest setbacks). The only difference between these two alternatives is the addition of modest setback levees in isolated locations. Therefore, the outputs and the costs of 3.1 and 3.2 are not distinctive enough to warrant carrying them forward as separate alternatives. Any ecosystem restoration opportunities as a result of the setbacks can be considered a first added increment should this new alternative move forward.

R-2 Implement Nonstructural measures across all structural alternatives

A standalone nonstructural alternative does not significantly address project objectives. Therefore, Alternative 1.1 will be modified by combining it with Alternative 2.4. Due to residual risk, nonstructural measures would enhance all project alternatives in achieving objectives and will be added to those alternatives as appropriate. See VE Concept R-5 below.

R-3 Eliminate Alternative 4.1

This alternative is significantly cost ineffective. The additional cost of this alternative compared to combined alternatives 3.1 and 3.2 exceeds the additional restoration benefits. However, if the hydraulic benefits of setting back the Sutter Bypass east levee in combination with other measures upstream and downstream of the study area result in greater system-wide benefits, then this alternative should be revisited.

R-4 Modify Alternative 2.1

Refine Alternative 2.1 by eliminating the individual ring levees around Biggs, Gridley, and Live Oak. The cost of constructing of ring levees around Biggs, Gridley, and Live Oak are significantly greater than the estimated annual benefits could support

The refined alternative consists of constructing a ring levee around Yuba City in combination with nonstructural measures focused on reducing risk in areas outside of the ring levee.

R-5 Combine Alternative 2.4 with Alternative 1.1

USACE policy requires a predominantly nonstructural alternative. This policy requirement could be achieved by adding a new Alternative 1.2 that is a combination of Alternative 2.4 and 1.1.

R-6 Eliminate Alternative 2.2

It was recommended that the Big "J" levee be eliminated from further evaluation based on a comparison with the Little “J” levee, which are functionally similar. The Big "J" levee and the Little “J” levee are expected to have similar flood damage benefits. However, the Big “J” levee would be approximately 30% greater in cost based on conceptual cost estimates. Additionally, the benefits associated with the Big “J” levee would be limited by the performance of the Sutter Bypass levees, which have a lower performance than the Feather River levees. The Little “J” levee does not utilize the Sutter Bypass levees and can therefore obtain a higher level of performance. Finally, if the design capacity of the Sutter Bypass reach of the Big “J” levee was exceeded, flood depths would be greater than existing conditions due to the height of the southern cross portion of the “J” levee (south of Yuba City). The flood depths would also increase at a faster rate due to less floodplain storage.

IDEA EVALUATION

EVALUATION PROCESS

Prior to development the creative ideas were evaluated to determine which ideas would be considered further and developed into VE Concepts. Each idea was evaluated with respect to the functional requirements of the project. Performance, cost, time, and risk were also considered during this evaluation.

Once each idea was discussed, it was given a rating. This is based on a go/no-go approach as indicated by the following rating index. This rating represents the subjective opinion of the VE team regarding the potential benefits of the concepts in order to prioritize them for development. Comments on the VE team's rating rationale are included as well.

1 = Develop	Concept results in performing project functions in a manner that results in increased value potential. Concepts in this rating group were considered relevant to the VE Study's analysis of the Conceptual Alternatives array and level of project development at the time of the study.
2 = Rationale for Rating	Concept is not technically feasible, does not meet project need and purpose, or represents programmatic operations outside of design development. **OR** Concept was considered not relevant to the VE Study and level of project development at the time of the study. Additional information or design development may be required for concept to be fully evaluated. Concepts in this rating group should be considered during later design development stages. Only ideas that were given a rating of 2 include the rationale for the rating.

Ideas rated 1 were developed further and those that were found to have the greatest potential for value improvement for the project were incorporated into the Final Conceptual Alternative Array.

IDEA SUMMARY LIST

Idea No.	Idea Description	Rating	Rating Rationale
1	Construct ring levee around Yuba City only in lieu of around other urbanized communities	1	
2	Extend the minimal fix in place alternative to Star Bend	1	
3	Close the J	2	Technically infeasible
4	Open the J on the southern end	2	Costly without benefit
5	Combine Minimal Fix in Place with ring levees around northern communities	2	Costly without benefit
6	Abandon southern portion of the project and return to natural floodplain	2	Requires further refinement
7	Install sensors in levees to monitor conditions for early warning system	2	Eliminate. Has maintenance issues. Costly
8	Convert SR-20 into causeway to facilitate evacuation	2	Costly
9	Convert SR-113 into causeway	2	Costly
10	Convert SR-99 into causeway	Combine with 24	
11	Extend Sutter Bypass to east	2	Affects beyond the study area, regional, system-wide impacts
12	Convert Cherokee Canal into bypass	2	Costly, affects beyond study area, fish affects
13	Connect Tisdale Bypass to Feather River	2	hydraulically Ineffective, fish passage affects
14	Implement widespread relocations of residences and businesses in project area	2	Costly due to widespread definition
15	Connect East interceptor to Feather River	2	hydraulically Infeasible

Idea No.	Idea Description	Rating	Rating Rationale
16	Construct safe havens / raised islands for area south of Yuba City	2	Consider during project development
17	Institute boat patrols for ring levee alternative	2	Consider during project development
18	Relocate portion of Sutter, CA that is within floodplain	2	
19	Construct structure on Yuba River to create storage	2	Large regional effects
20	Combine Alternative 3.1 and Alternative 3.2 and evaluate as single alternative	1	
21	Combine Alternatives 2.4, 2.5, and 3.1 and evaluate as single alternative	2	Alternatives have distinctiveness and outputs that needs to be demonstrated
22	Add inflatable rubber dam to increase capacity of Oroville	2	Outside of project scope, regional effects, would only provide rare event protection
23	Relocate measure S-24 (Gilsizer Cross Levee) further to north	2	Option of cross-levee alternative, but more costly
24	Construct evacuation routes for ring levee alternative	1	
25	Armor ring levees to resist failure from overtopping	2	Consider during project development
26	Incorporate nonstructural measures to improve Minimal Fix in Place alternative	1	
27	Adopt State's floodplain development regulations (wise use of floodplain). Institute state and local ordinances to avoid floodplain development	1	
28	Establish pre-stage flood fighting areas and equipment	1	
29	Implement housing standards for flood proofing of buildings in floodplain	2	Assumed as part of Without Project conditions
30	Coordinate emergency responses to all floodplain (in lieu of by county)	1	

Idea No.	Idea Description	Rating	Rating Rationale
31	Combine Alternatives 2.2 and 2.3 into single alternative	2	Little J has more significant impacts, residual risks are unique to alternatives
32	Consider removing homes nearest to existing levees	2	Already being considered as measures
33	Incorporate pump stations to enhance flood risk reduction provided by levees	2	Consider during project development
34	Develop plans to implement fuse plugs during flood event	2	Consider during project development
35	Develop plans to breach levees during flood event	2	Consider during project development
36	Consider rapid levee repair measures being developed by ERDC	2	Failures being considered are more significant than rapid repair measures could address
37	Add measure for Fix in Place for Sutter Triangle area	1	
38	Construct setback levee in Yuba City in location of depression (low lying area)	2	Consider during project development, Costly
39	Implement measures to support emergency evacuation (helicopters, trains, etc.)	2	Incorporated into emergency response plan
40	Consider surface berms in areas where development near levees permits	2	Consider during project development
41	Add relief wells	2	Consider during project development
42	Conduct geophysical survey of levees and implement measures to fix underseepage/through-seepage in critical areas only	2	Extent of fixes would be similar to full fix in place
43	Construct hydraulic elevation control in southern part of basin to prevent preclude certification of southern segment levees to 200 years.	1	
44	Convert J alternatives to construct L with gap	2	Hydraulic infeasible, water outflanks it
45	Compartmentalize the basin	2	Consider during future project development,

Idea No.	Idea Description	Rating	Rating Rationale
			optimization option
46	Perform evaluation of existing levees per segment to determine measures in each area	2	Has been completed
47	Allow adaptable fix in place over time to address problem areas as they arise	2	Implementation/phasing strategy of ultimate project solution
48	Exempt slurry walls from 408 certification process	1	
49	Allow slurry walls be constructed wherever needed	Combines with 49	
50	Construct "straight" alignment of offset Feather River levees to reduce O&M	2	Consider as enhancement of S-10, political ramifications need to be considered, new levee is 3 times the cost of fix in place, thus alternative is costly
51	Consider constructing soil cement levees	2	Consider during future project development, optimization option
52	Authorize funds for Sac bank	2	Outside of project scope and addressed by other study
53	Incorporate fuse gates into Ring Levee alternative	2	Design detail
54	Reduce height of northern ring levees to 100 year event	2	Consider during project development
55	Combine ring levee around Biggs and Gridley into single ring	2	Costly, combines "bathtubbing"
56	Elevate structures inside ring levees and promote additional agricultural development outside	2	Costly
57	Transfer ring levees to local authorities	2	Could consider local input to ring levee alignments
58	Use borrow areas from inside ring levees and use for interior storage	2	Could create seepage problems

Idea No.	Idea Description	Rating	Rating Rationale
59	Implement non-structural measures across all structural alternatives in lieu of holding independent non-structural alternative	1	
60	Minimize flood risk reduction measures to areas south of Big J levee to allow agricultural activities under reduced protection	1	
61	Incorporate minimal protection of areas to allow agricultural use without growth inducement	Combine with 61	
62	Fix problem areas identified by PL-8499 program only	1	
63	Add Measure S-15 (Southern Relief Feature) as an option to Alternative 2.2	2	Breach so far south would be self-draining
64	Implement levee overtopping protection in select areas	2	Consider during future project development, considered by current measures
65	Construct transverse hydraulic conveyance measure in lieu of cross-levee	2	Hydraulic infeasible
66	Add S-15 (southern relief feature) to Alternatives 2.3, 2.4, 2.5	1	
67	Expand Gilsizer slough to handle or divert flood waters	2	Hydraulic infeasible
68	Add Measure S-27 (improve upstream fish passage) to Alternatives 3.2	2	Wouldn't change the selection of the measure
69	Include hydraulic control on southern portion of basin into Alternative 3.1 and 3.2	2	Consider during future project development
70	Incorporate additional setback levee locations into Alternative 3.2	2	Consider during future project development
71	Modify Measure S-26 (managed overtopping) to include selective superiority based on geotechnical	2	Design detail

Idea No.	Idea Description	Rating	Rating Rationale
72	Use deep soil mixing in lieu of slurry walls for fix in place measures	2	Design detail
73	Use fly ash slurry in lieu of bentonite slurry for fix in place	2	Design detail
74	Consider structural flood walls in locations of limited ROW	2	Design detail
75	Include Sutter Bypass levee full setback in Alternative 3.1 per CVFPP plan	2	Regional impacts, system-wide effects, relies on others
76	Use relief wells in lieu of levee improvements	2	Design detail
77	Over construct levee crowns to support emergency borrow and safe havens	Combine with 24	
78	Develop evacuation routes to access Sutter Butte during flood event	Combine with 24	
79	Elevate existing roads to serve as interim cross-levees	2	Less expensive to construct adjacent to roads than raise roads
80	Over-widen ring levees	2	Lack of material, costly
81	Allow farming on levees	2	Infeasible and conflicts with policies, only works on over-widened levees
82	Consider secant pile wall for flood wall structures	2	Design detail
83	Use vinyl sheetpile for flood wall structures	2	Design detail
84	Create floatable critical structures	2	Technical infeasible
85	Allow all underground parking structures to flood for storage purposes	2	Technical infeasible
86	Use barges for evacuation of people	2	Technical infeasible
87	Instigate penalties for development in floodplain	2	Programmatic issue
88	Put flood insurance into exchange program that pays for	2	Programmatic issue

Idea No.	Idea Description	Rating	Rating Rationale
	improvements		
89	Elevate all critical structures	2	Included in non-structural measure analysis, modify NS-3 to include critical infrastructure
90	Designate and develop natural floodways within project area	2	hydraulically Infeasible
91	Construct bypass in northern portion of project	2	Previously considered and rejected due to cost and fish passage
92	Construct U levee on northeast side of northern communities	2	hydraulically Infeasible due to topography
93	Upgrade and modification of Tisdale weir	2	Regional impacts, system-wide effects, outside of project/study scope
94	Widen and improve Fremont weir	2	Previously dismissed, Outside of project scope, regional effects, requires improvements by others
95	Install measures to improve fish passage on Sutter Bypass	2	Already being done or considered as measure
96	Install control structure at Feather River and Cherokee Canal bypass	2	Control structure only relevant for bypass channel
97	Eliminate Alternative 4.1 from future consideration	1	
98	Eliminate Alternative 2.1 from consideration	1	
99	Eliminate Alternative 2.4 from consideration	1	
100	Combine and optimize Alternative 2.5, 3.1 and 3.2	2	Alternatives have distinctiveness and outputs that needs to be demonstrated
101	Eliminate Alternative 2.3 from consideration	1	
102	Widen Sutter Bypass south of study area and southern portion of project limits to reduce depths	2	Requires improvements outside of project limits, relies on others to implement, downstream impacts

Idea No.	Idea Description	Rating	Rating Rationale
103	Construct new Feather River bridge south of Star Bend	Combines with 24	
104	Forecast reservoir operations to lower stage downstream	2	Regional considerations, impacts water supply
105	Redirect water by altering existing areas, regrade mining tailings	2	Consider during future project development, already being considered
106	Manage hydraulic flows and characteristics in floodway to reduce impacts from floods	2	Consider during future project development, already being considered
107	Manage vegetation to optimize hydraulic conveyance in channels and maintain ecosystem function	2	Consider during future development

VALUE ANALYSIS OF
OF FINAL ALTERNATIVES ARRAY

VALUE ANALYSIS OF FINAL ALTERNATIVES ARRAY

FINAL ALTERNATIVE ARRAY SUMMARY

The following summarizes the scope of work of the final alternatives.

All Alternatives

- Coordinated flood warning and evacuation system
- Pre-staging equipment and flood fighting areas (Measure NS-9)
- Levees surrounding urban and urbanizing areas should consider SB-5 requirement of 1/200 flood risk reduction
- Consider economic and flood risk reduction justification for setback levee alignments and isolated weak spots as supplemental options where feasible

Primarily Nonstructural with Minimal Levee Improvement Reaches

- Improve Feather River Levees from Sunset Weir to Star Bend
- Implement non-structural measures focused on reducing risk to loss of life
- Prioritize properties based upon annualized economic value and flood risk probability to determine which structures get relocated or flood-proofed (likely focused on critical infrastructure and large industrial properties)
- Some evacuation route or refuge area improvements may be necessary

Yuba City Ring Levee

- Construct ring levee around Yuba City
- Implement non-structural measures focused on reducing risk to loss of life
- Mitigations for induced damages resulting from ponding on north side of ring levee
- Some evacuation route or refuge area improvements may be necessary
- Prioritize properties based upon annualized economic value and flood risk probability to determine which structures get relocated or flood-proofed (likely focused on critical infrastructure and large industrial properties)

Little "J" Levee

- Improve Feather River Levees from Thermalito to Shanghai Bend
- Construct partial southern cross-levee
- Construct levee north of cross-levee on west side of Yuba City
- Assume alignment of southern levee to be identical to southern levee of ring levee alternative. Levee alignment will be based upon flood risk reduction of existing development with possible consideration to accommodate sphere of influence

Fix in Place Feather River from Thermalito to Star Bend

- Improve Feather River Levees from Thermalito to Star Bend
- Includes Star Bend setback levee
- Implement non-structural measures focused on reducing risk to loss of life
- Prioritize properties based upon annualized economic value and flood risk probability to determine which structures get relocated or flood-proofed (likely focused on critical infrastructure and large industrial properties)
- Some evacuation route or refuge area improvements may be necessary

Fix in Place Feather River, Sutter Bypass, and Wadsworth Canal

- Improve Feather River Levees from Thermalito to Sutter Bypass Confluence (southern basin)
- Improve Sutter Bypass East Levee from Wadsworth Canal to the Feather River and the Wadsworth Canal East Levee, East Interceptor to the Sutter Bypass
- Includes Star Bend setback levee
- Includes Northern Feather River setback levee
- Improve Wadsworth Canal South Levee
- Optional Sutter Triangle levee improvement
- Consider economic and flood risk reduction justification for setback levee alignments and isolated weak spots as supplemental options where feasible
- Optional consideration of "full" Sutter Bypass East Levee setback

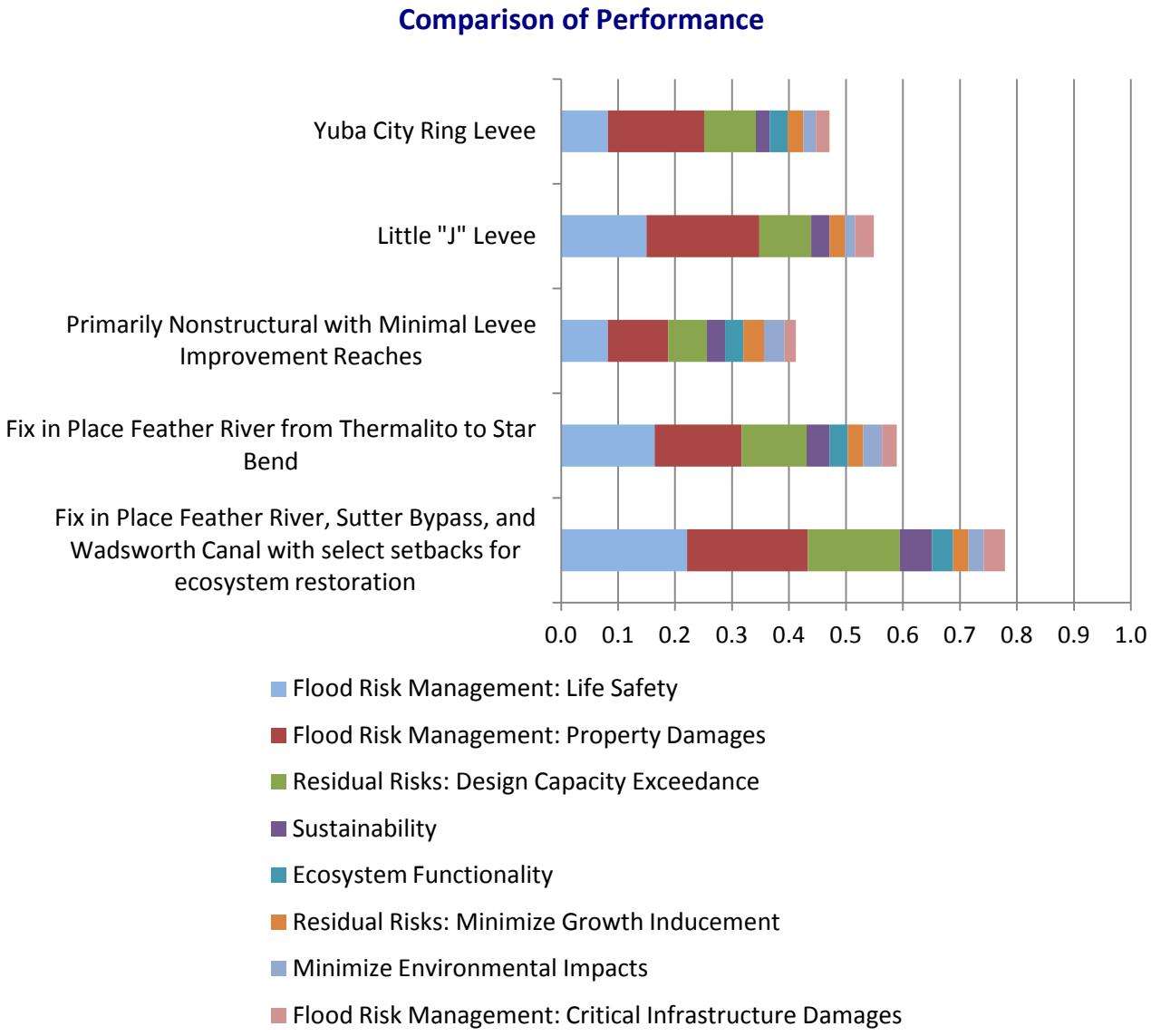
VALUE METRICS

Measure Performance of Final Alternatives

The project team and stakeholders evaluated the performance of the Final Alternatives relative to the performance attributes previously identified.

Compare Performance of Final Alternatives

The total performance scores reflect the performance rating for each attribute multiplied by its overall priority (weight) expressed using a ratio scale. A total performance score of "1" would indicate the highest level of desired performance (i.e., "ideal" performance). The following chart compares the total performance scores for the final alternatives.



The information below reflects the performance ratings and associated rationale for each attribute.

Yuba City Ring Levee

Flood Risk Management: Life Safety
Rating: **3.0**

Rationale: Ring levees protect a majority of the concentrated population and property. Evacuation routes are assumed to be into the areas surrounded by the ring levees, however, it is assumed some measure of evacuation route will be provided. The ring levee around Yuba City is partially part of the Feather River levee system, thus there is only one line of protection (vs. two layers from the ring levees of the other communities). Locations outside of the ring levees are excluded from the additional protection, however, these areas are relatively small in population density. Does not reduce flood risk in areas outside of ring levee (i.e. northern communities of Gridley, Biggs, and Live Oak and southern basin). Ring levees rely on flood gates and other measures at crossings with

railroads and roadways to be actively operated in order to be effective. Pump stations are required to maintain flood protection. Non-structural measures will be implemented to reduce risk to life safety. Any project that relies on the existing levee has a higher life safety risk due to less predictable performance (levees can fail prior to overtopping at any location).

Flood Risk Management: Property Damages
Rating: **7.2**

Rationale: Protects key urban development areas, thus property damages from flood events should be minimized. The ring levees around just Yuba City accounts for protecting 77% of all property values. Some agricultural and some rural structures would still be exposed to flood risk. Captures approximately 72% of total benefits.

Residual Risks: Design Capacity Exceedance
Rating: **4.0**

Rationale: Does not correct deficient flood risk in areas not surrounded by ring levees. Evacuation routes are assumed to be into the areas surrounded by the ring levees, however, it is assumed some measure of evacuation route will be provided. The ring levee around Yuba City is partially part of the Feather River levee system, thus there is only one line of protection (vs. two layers from the ring levees of the other communities). Ring levees may create an exacerbated situation of a catch basin for flood waters when a breach in the levee occurs. Locations outside of the ring levees (non-urban areas) are excluded from the additional protection.

Sustainability
Rating: **3.0**

Rationale: Alternative requires maintenance of pump stations and closure structures to ensure effective continued operation and flood risk management. Ring levees on new alignments would be constructed on new foundations and to modern engineering standards. Requires maintaining existing levees as well as the additional ring levees surrounding Yuba City. Revision to Alternative results in significantly less new ring levees and fewer pump stations and closure structures.

Ecosystem Functionality
Rating: **6.0**

Rationale: Opportunities exist for ecosystem restoration projects on the existing levees at Yuba City where they are combined with the ring levees. There is little opportunity for ecosystem restoration on other portions of the project. Constructing ring levees may invade existing functioning ecosystems. Preserving existing levees may allow future ecosystem restoration projects.

Residual Risks: Minimize Growth Inducement
Rating: **6.0**

Rationale: Limits growth of local communities and future regional growth. The ring levees around northern communities had limited space to allow future development, thus rating did not change when these ring levees were eliminated.

Minimize Environmental Impacts
Rating: **5.0**

Rationale: Preserves the existing floodplain while minimizing the potential for future growth and its adverse effects on air quality and other resources. Conflicts with local land use plans. Protects existing urban development but not areas approved for future growth in local land use plans. Direct impacts from construction could affect environmentally and culturally sensitive areas within the new levee footprint. Ring laves separate the communities from their surrounding supporting areas. Pump stations will have to be operated periodically which may create air quality and noise impacts. Potential HTRW issues on new levee alignments. Construction of levees in urban areas which are more susceptible to air and noise quality impacts. Requires multiple crossings of railroads and crossing two significant drainage culverts in Yuba City. Requires significant borrow material to construct levees. Ring levees would impact the view sheds.

Revision to Alternative results in significantly reduced environmental impacts due to reduced ring levee reaches.

Flood Risk Management: Critical Infrastructure Damages
Rating: **6.0**

Rationale: Ring levees protect medical facilities and other critical infrastructure within the concentrated areas, but do not protect roadways and railroads.

Little "J" Levee

Flood Risk Management: Life Safety
Rating: **5.5**

Rationale: Evacuation route on Westbound Route 20 is cut off. Areas in the southern portion of the project (below Sutter Bypass levee) would remain at risk to flood. Cuts off two major drainage areas in Yuba City.

Flood Risk Management: Property Damages
Rating: **8.4**

Rationale: Captures approximately 84% of total benefits. Ten percent of benefits captured would be agricultural and residual.

Residual Risks: Design Capacity Exceedance
Rating: **4.0**

Rationale: Evacuation route on Westbound Route 20 is cut off. Areas in the southern portion of the project (below Sutter Bypass levee) would remain at risk to flood. Flood depths would be greater (significantly more than 3 feet) and faster due to more concentration of flooding in areas north of Little J levee due to capturing of flood water from upstream levee breach. Cuts off two major drainage areas in Yuba City.

Sustainability
Rating: **4.0**

Rationale: Alternative requires maintenance of pump stations and closure structures to ensure effective continued operation and flood risk management.

Ecosystem Functionality
Rating: **6.0**

Rationale: Opportunities exist for ecosystem restoration projects on the existing levees. There is little opportunity for ecosystem restoration on other portions of the project. Preserving existing levees may allow future ecosystem restoration projects.

Residual Risks: Minimize Growth Inducement
Rating: **6.0**

Rationale: Reduces flood risk to Yuba City and other existing urbanized areas. Focuses development in areas designated or already developed in lieu of encouraging development scattered through floodplain.

Minimize Environmental Impacts
Rating: **4.0**

Rationale: Construction of new cross-levee would directly impact farmland and potential sensitive habitat areas. Construction impacts would be limited if land disturbance is confined to existing levee footprints. Seepage berms, canal relocations, and land requirements could impact adjacent environmentally sensitive habitats and structures. Construction of cutoff walls could potentially disrupt groundwater flows. Potential HTRW issues on new levee alignments. Construction of levees in urban areas that are more susceptible to air and noise quality impacts. Requires crossing two significant drainage systems in Yuba City. Requires significant borrow material to construct levees. New cross-levees may impact view sheds. Separates the agricultural areas in the southern portion of the project.

Flood Risk Management: Critical Infrastructure Damages
Rating: **8.0**

Rationale: Alternative protects all hospitals, power plants, and other critical infrastructure but does not protect certain roadways within project limits.

Primarily Nonstructural with Minimal Levee Improvement Reaches

Flood Risk Management: Life Safety
Rating: **3.0**

Rationale: Reduces flood risk to certain portion of project limits only and would not reduce flood risk to communities in northern area of project limits (Live Oak, Gridley, and Biggs) or portions of Yuba City. Majority of life risk occur in areas south of the Yuba River and Feather River confluence and in Yuba City, which this alternative does address. Cuts off all major evacuation routes (SR-99 and

Westbound SR-20). Eastbound SR-20 evacuation route would remain. Does not create ponding issue caused by cross-levees. Non-structural measures will be implemented to reduce risk to life safety. Any project that relies on the existing levee has a higher life safety risk due to less predictable performance (levees can fail prior to overtopping at any location).

Flood Risk Management: Property Damages
Rating: **4.5**

Rationale: Captures approximately 45% of total benefits. Exposes the maximum amount of property to potential damage. Alternative provides least amount of flood risk reduction to the project. Yuba City includes 77% of total property values in the project limits. Alternative provides flood risk reduction to approximately half of Yuba City, thus achieving some reduction in property damages. Provides some protection to agricultural lands.

Residual Risks: Design Capacity Exceedance
Rating: **3.0**

Rationale: Given limited extent of levee improvements, design capacity is exceeded on a frequent basis. Cuts off all major evacuation routes (SR-99 and Westbound SR-20). Eastbound SR-20 evacuation route would remain. Does not create ponding issue caused by cross-levees, however, deeper ponding in southern portion would occur.

Sustainability
Rating: **4.0**

Rationale: Minimum amount of existing levees are improved, thus maintenance efforts are greater as compared to fixed in place.

Ecosystem Functionality
Rating: **6.0**

Rationale: Opportunities exist for ecosystem restoration projects on the existing levees. There is little opportunity for ecosystem restoration on other portions of project. Preserving existing levees may allow future ecosystem restoration projects.

Residual Risks: Minimize Growth Inducement
Rating: **8.0**

Rationale: Protects Yuba City and other communities, however, provides limited risk reduction in all other areas of the project limits.

Minimize Environmental Impacts
Rating: **8.0**

Rationale: Construction impacts would be limited if land disturbance is confined to existing levee footprints. Seepage berms, canal relocations, and land requirements could impact adjacent environmentally sensitive habitats and structures. Construction of cutoff walls could potentially disrupt groundwater flows.

Flood Risk Management: Critical Infrastructure Damages
Rating: **5.0**

Rationale: Does not provide flood risk reduction for key critical infrastructure (hospitals, power plants) and does not provide flood risk reduction for roadways or railroads within project limits.

Fix in Place Feather River from Thermalito to Star Bend

Flood Risk Management: Life Safety
Rating: **6.0**

Rationale: Provides consistent level of flood risk reduction to northern areas and communities within project limits as well as to Yuba City. Does not provide flood risk reduction from an event in the western portion of project areas. Due to the downstream levee height and its impacts on backwaters, fixing south of Star Bend there is an inflection point on life safety. Cuts off SR-20 Westbound and SR-113 as evacuation routes.

Flood Risk Management: Property Damages
Rating: **6.5**

Rationale: Captures approximately 65% of total benefits. Ten percent of benefits captured would be agricultural and residual.

Residual Risks: Design Capacity Exceedance
Rating: **5.0**

Rationale: Design capacity is exceeded on a frequent basis, however, the levees in northern segments of Feather River would be improved thus the probability of potential breach is reduced. Cuts off all major evacuation routes (SR-99 and Westbound SR-20). Eastbound SR-20 evacuation route would remain. Does not create ponding issue caused by cross-levees, however, some ponding in southern portion would exist.

Sustainability
Rating: **5.0**

Rationale: Improves segments of existing levees, reducing maintenance requirements. Retains Sutter Bypass levees and Feather River levees below Star Bend as they exist.

Ecosystem Functionality
Rating: **6.0**

Rationale: Limited opportunities for ecosystem restoration projects where levees are fixed in place. However, any levee setback options exercised would create opportunities for restoration of riparian and wetland habitats within the setback areas (700 acres). Wider river channel contributes to improvements in fish habitats.

Residual Risks: Minimize Growth Inducement
Rating: **6.0**

Rationale: Provides flood risk reduction to significant portion of study area, thus removing flood risk as an obstacle to future regional growth and development to these areas.

Minimize Environmental Impacts
Rating: **7.5**

Rationale: Construction impacts would be limited if land disturbance is confined to existing levee footprints. Seepage berms, canal relocations, and land requirements could impact adjacent environmentally sensitive habitats and structures. Construction of cutoff walls could potentially disrupt groundwater flows.

Flood Risk Management: Critical Infrastructure Damages
Rating: **6.5**

Rationale: Alternative protects all hospitals, power plants, and other critical infrastructure but does not protect certain roadways within project limits.

Fix in Place Feather River, Sutter Bypass, and Wadsworth Canal with select setbacks for ecosystem restoration

Flood Risk Management: Life Safety
Rating: **8.1**

Rationale: Provides flood risk reduction to the most areas within the project limits. Does not create ponding issue caused by cross-levee of the Little J Alternative. Does not provide flood risk reduction from an event in the western portion of project areas. Protects evacuation routes for SR-20 and SR-113. Reduces flood risk to southern part of project limits. Setbacks reduce the water surface elevation. Marginal factor of safety improvements due to levees built on new foundations.

Flood Risk Management: Property Damages
Rating: **9.0**

Rationale: Captures approximately 90% of total benefits. Ten percent of benefits captured would be agricultural and residual. Some flood stage reduction is possible.

Residual Risks: Design Capacity Exceedance
Rating: **7.1**

Rationale: Provides flood risk reduction to the most areas within the project limits. Does not create ponding issue caused by cross-levee of the Little J Alternative and provides the most area for ponding in southern portion. Does not provide flood risk reduction from an event in the western portion of project areas. Protects evacuation routes for SR-20 and SR-113. Reduces flood risk to southern part of project limits. Setbacks allow levees to withstand erosion during design exceedance better than fixing existing levees.

Sustainability
Rating: **7.1**

Rationale: Improves majority of segments of existing levees, reducing maintenance requirements. Does not add any additional segments of levees to be maintained. Offset segments will be constructed on new foundations and to latest engineering standards, thus reducing maintenance efforts. Offset segments will have access points and distances to allow maintenance vehicles access.

Ecosystem Functionality
Rating: **7.0**

Rationale: Levee setbacks would create opportunities for restoration of riparian and wetland habitats within the setback areas (700 acres). Wider river channel contributes to improvements in fish habitats.

Residual Risks: Minimize Growth Inducement
Rating: **6.0**

Rationale: Provides flood risk reduction to the entire study area, thus removing flood risk as an obstacle to future regional growth and development.

Minimize Environmental Impacts
Rating: **6.0**

Rationale: Same as Alternative 3.1, but where modest setback levees are proposed, construction may require removal or relocation of structures and loss of farmland. Seepage berms, canal relocations, and land requirements could impact adjacent environmentally sensitive habitats and structures. Construction of cutoff walls could potentially disrupt groundwater flows.

Flood Risk Management: Critical Infrastructure Damages
Rating: **9.0**

Rationale: Alternative protects all hospitals, power plants, and other critical infrastructure as well as all roadways and railroads within project limits.

Compare Value

The cost elements were compared and normalized for the Final Alternatives using the table on the following page. This table illustrates how the cost scores were derived. In this comparison, a lower score is desirable as the project will benefit from lower costs.

Strategies	Cost	Score
Yuba City Ring Levees	$482,900,000	0.103
Little "J" Levee	$839,200,000	0.179
Primarily Nonstructural with Minimal Levee Improvement Reaches	$267,000,000	0.057
Fix in Place Feather River from Thermalito to Star Bend	$651,800,000	0.139
Fix in Place Feather River, Sutter Bypass, and Wadsworth Canal with select setbacks for ecosystem restoration	$1,376,900,000	0.294
TOTAL	**$4,688,700,000**	**1.000**

Once relative scores for performance and cost have been derived, the next step is to synthesize a value index for the alternatives. The basic equation for value is:

$$Value = \frac{Performance}{Cost + Time}$$

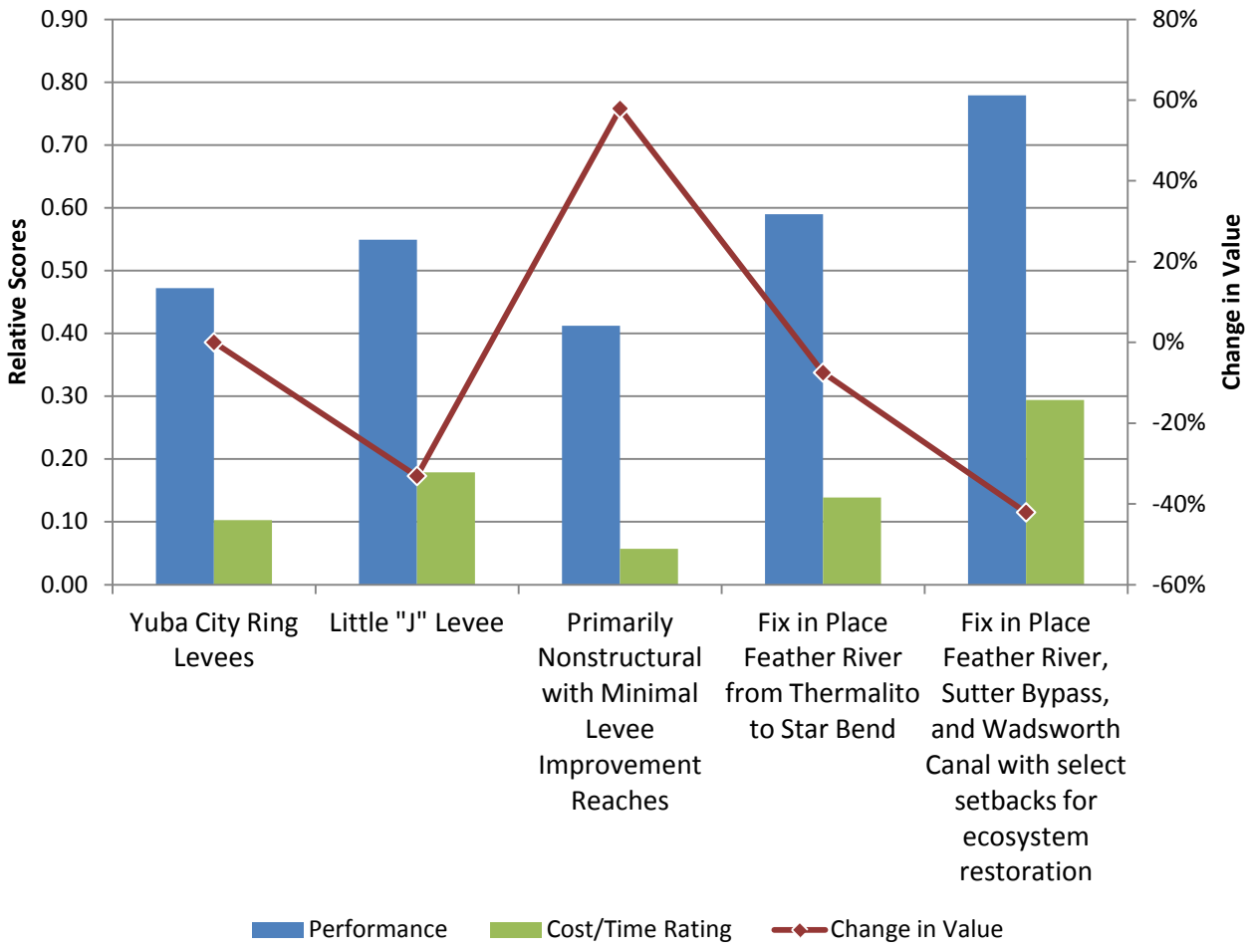
A Value Matrix was prepared which facilitated the comparison of the alternatives by organizing and summarizing this data into a tabular format. The performance scores for each alternative were divided by the total cost/time scores for each alternative to derive a value index.

Value Matrix

Final Conceptual Alternatives

Strategies	Performance Score	Cost/Time Score	Value Index
Yuba City Ring Levees	0.472	0.103	4.585
Little "J" Levee	0.549	0.179	3.066
Primarily Nonstructural with Minimal Levee Improvement Reaches	0.412	0.057	7.242
Fix in Place Feather River from Thermalito to Star Bend	0.590	0.139	4.242
Fix in Place Feather River, Sutter Bypass, and Wadsworth Canal with select setbacks for ecosystem restoration	0.779	0.294	2.654

Comparison of Value – Final Conceptual Alternatives



VALUE ENGINEERING/ PLANNING CHARETTE PROCESS

VALUE ENGINEERING/PLANNING CHARETTE PROCESS

This report section describes the procedures used during the VE study/Planning Charette. It is followed by the workshop agenda and workshop attendance sheets.

A systematic approach was used in the VE study and the key procedures followed were organized into three distinct parts: (1) Pre-Study Preparation, (2) VE Study/Planning Charette Workshop, and (3) Post-Study Procedures.

PRE-STUDY PREPARATION

In preparation for the VE study/Planning Charette, the team leader reviewed critical aspects of the project and areas for improvement with the Project Delivery Team (PDT). In the week prior to the start of the workshop, preliminary performance attributes and requirements and project risks were identified that would later be reviewed and verified during the workshop.

VE STUDY/PLANNING CHARETTE WORKHSOP

The VM job plan was followed to guide the team in the consideration of project functionality and performance, potential schedule issues, high cost areas, and risk factors in the design. These considerations were taken into account in developing alternative solutions for the optimization of project value. The job plan phases are described in order below.

Information Phase

At the beginning of the workshop, a presentation of the project was made by representatives from the PDT. This presentation included an overview of the project and a brief history of the project background and its current status. The workshop attendees were then led through a discussion that included the project's mission (purpose and need) and identification of the project objectives.

Function Phase

Key to the VM process is the function analysis technique used during the Function Phase. Analyzing the functional requirements of a project is essential to assuring an owner that the project has been designed to meet the stated criteria and its need and purpose. The analysis of these functions in terms cost, performance, time, and risk is a primary element in a VE study, and is used to develop alternatives. This procedure is beneficial to the VE team, as it forces the participants to think in terms of functions and their relative value in meeting the project need and purpose. This facilitates a deeper understanding of the project.

Speculation Phase

The Speculation Phase involves identifying and listing creative ideas. During this phase, the VE team participated in a brainstorming session to identify as many means as possible to provide the necessary project functions. Judgment of the ideas was not permitted in order to generate a broad range of ideas.

The idea list includes all of the ideas suggested during the study. These ideas should be reviewed further by the project team, since they may contain ideas that are worthy of further evaluation and may be used as the design develops. These ideas could also help stimulate additional ideas by others.

Evaluation Phase

The purpose of the Evaluation Phase is to systematically assess the potential impacts of ideas generated during the Speculation Phase relative to their potential for value improvement. Each idea was evaluated in terms of its potential impact to performance, cost, time, and risk. Once each idea is fully evaluated, it is rated on develop/eliminate basis, as set forth in the *Idea Evaluation* section of this report.

Development Phase

During the Development Phase, the highly rated ideas were expanded and developed into VE concepts. The development process included describing the concept in more detail and narrative discussion of the concept's impact on the performance attributes.

Presentation Phase

The VE study/Planning Charette concluded with a presentation of the VE team's assessment of the project and the VE concepts. The presentation provided an opportunity for the project stakeholders to preview the project objectives and performance attributes as well as the VE concepts identified by the VE team and develop an understanding of the rationale behind them.

POST-STUDY PROCEDURES

A Draft VE Study/Planning Charette Report was prepared after the completion of the workshop. This report summarized the activities and results of the VE study. When the draft report was reviewed by the PDT and other stakeholders, the Final VE Study/Planning Charette Report is prepared incorporating any review comments received.

Workshop Agenda
Value Engineering Study and Planning Charette
Sutter Basin Pilot Study – Sutter County, CA

Day 1 – Monday, October 31, 2011; Location: COE-Sacramento District Offices, Room 814 (8th floor)

0800 VE Team Set-up

0830 Introductions; VE Process Overview and Agenda Review,
Information Gathering (Planning Process Steps 1, 2, & 3): Overview of problems, opportunities, objectives and constraints; Discuss future and w/o project conditions; Present conceptual alternatives previously identified; Present risk analysis results

1130 Lunch

1230 Develop/Review Project Purpose & Need Statement

1300 Function Analysis

1400 Analyze Project Performance using Value Metrics

- Define/Review Performance Requirements and Performance Attributes
  Identify attributes that represent those aspects of a project's scope that possess a range of potential values
- Determine Relative Importance of Attributes (Stakeholder voting to determine Attribute priorities)

1600 Adjourn

Day 2 – Tuesday, November 1, 2011; Location: COE-Sacramento District Offices, Room 814 (8th floor)

0830 Present and Discuss FAST Diagram

0900 Evaluation Phase (Planning Process Step 4): Evaluation of previous Conceptual Alternatives based on Performance Attributes

1200 Lunch

1300 Speculation Phase (Planning Process Step 3): Brainstorming of additional alternatives, alternative optimization, value improvements recommendations, and risk reduction/mitigation

1600 Adjourn

Day 3 – Wednesday, November 2, 2011; Location: COE-Sacramento District Offices, Room 814 (8th floor)

0830 Evaluation of Creative Ideas

1130 Lunch

1230 Team Assignments for Development of Alternative Narrative Write-ups

1600 Adjourn

Day 4 – Thursday, November 3, 2011; Location: COE-Sacramento District Offices, Room 814 (8th floor)

0830 VE Alternative Development

1130 Lunch

1230 Re-evaluation of conceptual alternatives and identify final array of alternatives
Planning Process Step 5: Comparison of final array of alternate plans

1600 Adjourn

Day 5 – Friday, November 4, 2011; Location: COE-Sacramento District Offices, Room 814 (8th floor)

0830 Summary of VE Results and Presentation Preparation

1000 Presentation of VE Study Results to all Project Stakeholders
Summary, Wrap-Up, Steps Forward

1200 Adjourn

MEETING ATTENDEES
Value Engineering Study and Planning Charette
Sutter Basin Pilot Study

2011 October/November					NAME	ORGANIZATION	POSITION / RANK	PHONE	EMAIL
31	1	2	3	4					
x	x	x	x	x	Mark Watson	Value Management Strategies, Inc.	VE Team Leader	(816) 206-0067	mark@vms-inc.com
x	x	x	x	x	Ron Tanenbaum	Value Management Strategies, Inc.	VE Team Leader	(858) 204-7942	ron@vms-inc.com
x	x	x	x	x	Mary Diel	USACE - Sacramento District	Value Engineering Officer	(916) 557-6833	mary.r.diel@usace.army.mil
x	x	x	x	x	Robert Vrchoticky	USACE - Sacramento District	Civil Engineer/Cost Engineering	(916) 557-7336	robert.d.vrchoticky@usace.army.mil
x				x	Bill Edgar	Sutter Butte	Executive Director	(916) 392-4909	bedgar@edgarandassociates.com
x	x	x	x	x	Dave Peterson	SBFCA	Consultant	(916) 792-6285	dpeterson@pbieng.com
x	x	x	x	x	Steve Holmstrom	USACE - Sacramento District	Hydrology/PDT	(916) 557-7129	steven.f.holmstrom@usace.army.mil
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x	x	x	x	x	Matt Davis	USACE - Sacramento District	Environmental	(916) 557-6208	mathew.g.davis@usace.army.mil
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